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The flume.

New York (State.) Water supply commission.

FIFTH ANNUAL REPORT

OF THE

STATE WATER SUPPLY COMMISSION

OF

NEW YORK

For the Year Ending February 1, 1910

Compliments of

State Water Supply Commission

TRANSMITTED TO THE GOVERNOR AND LEGISLATURE
FEBRUARY 1, 1910

ALBANY
J. B. LYON COMPANY, PRINTERS
1910

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Part I. Municipal Water Supply.

Part II. River Improvement and Flood Prevention.

Part III. Water Storage and Power Development.

TRANSMITTED TO THE GOVERNOR AND LEGISLATURE
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1910

Prof. John C. Parker,
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STATE OF NEW YORK

No. 34.

IN ASSEMBLY

FEBRUARY 1, 1910.

FIFTH ANNUAL REPORT OF THE STATE WATER SUPPLY COMMISSION.

ALBANY, *February* 1, 1910.

Honorable James W. Wadsworth, Jr., Speaker of the Assembly:

Dear Sir: In compliance with the requirements of Article 2 of the State Boards and Commissions Law the State Water Supply Commission herewith transmits to the Legislature its report for the year ending February 1, 1910.

Very respectfully,

HENRY H. PERSONS,
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

411751

STATE WATER SUPPLY COMMISSION.

Commissioners.

HENRY H. PERSONS, President	East Aurora
*ERNST J. LEDERLE	New York
JOHN A. SLEICHER	New York
MILO M. ACKER	Hornell
CHARLES DAVIS	Saugerties

Officers.

WALTER McCULLOH, Consulting Engineer	Niagara Falls
CURTIS E. LAKEMAN, Secretary	New York

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*Resigned, January 11, 1910.

TABLE OF CONTENTS.

Report of the Commission. PAGE.

Letter of transmittal to the Legislature 7

PART I.

Municipal Water Supply.

Applications received during the year 13
Statistics of systems approved 16

PART II.

River Improvement and Flood Prevention.

General summarized statement of progress during the year 19
Amendment of law to provide for river improvement districts 20
Canaseraga creek improvement 23
Genesee river improvement 24
Hudson river improvement 27
Local river improvements 28
Needed amendments to River Improvement Law 30

PART III.

Water Storage and Power Development.

Law directing water power investigations 37
I. General summary 40
  Water resources of New York 40
  Possible developments 41
  Provisions of the law 42
  Limitations of investigations 42
  Summary of results 44
  Plan of report 47
II. Review of surveys and investigations 49
  Investigations of season of 1907 49
  First progress report 51
  Investigations of season of 1908 52
  Second progress report 58
  Investigations of season of 1909 58
III. Opportunities for water storage and power development 62
  Relation of storage reservoirs to power developments 62
  Hudson river 64
    Sacandaga project 66
    Schroon project 70
    Comparative advantages of the Sacandaga and Schroon projects 73
  Genesee river 74
  Raquette river 77
  Reconnaissance studies of Oswego, Black, Oswegatchie, Salmon (Oswego county), Grasse, St. Regis, Salmon (Franklin county), Saranac, Ausable and Chateaugay rivers, Cattaraugus creek and other streams 80
IV. State conservation of water power 90
  Means of regulating stream flow 90
  Scope of the inquiry 93
  Need of a public policy 93
  Importance of State control 94
  State lands required 99

PAGE.

- Constitutional aspects of State control 101
- Amendment of constitution to permit water storage fund bond issue. 108
- Alternative theories of State control of water storage 109
- Development plan suggested by the Commission 110
- Recommendations 112
- Conclusion 113

Draft of Bill for General Law 117

Reports of Engineers.

I. Report of Walter McCulloh, consulting engineer 131
- Water supply 131
  - Statistics of progress of plants affected by applications granted by the Commission 135
- Engineering organization 138
- River improvement 140
  - Genesee river, Genesee floods, Canaseraga creek, Raquette river. 140
- Water power and storage
  - Eastern division surveys: Schroon, Sacandaga 146
  - Eastern division reconnaissances: Ausable, Saranac, Chazy, Boquet, Lake George Outlet, Chateaugay 147
  - Northern division surveys: Raquette river, Piercefield dam, Little Tupper project, Forked lake 150
  - Northern division reconnaissances: Black river, Beaver river, Salmon (Oswego county), Oswego, Grasse, St. Regis, Salmon (Franklin county), St. Lawrence 154
  - Western division surveys: Genesee river 169
  - Western division reconnaissances: Cattaraugus creek, minor tributaries to Lake Erie and Lake Ontario, Lake Chautauqua outlet, Upper Genesee, Allegany 169
  - Albany headquarters operations: Summary of office studies, auxiliary regulating reservoirs, summarized power estimates, rainfall studies, streamflow studies, mapping, State fair 172
- Special investigation of State lands involved 180
- Summarized conclusions and recommendations
  - Fuller Act 185
  - Sacandaga 188
  - Schroon 190
  - Portage 192
  - Little Tupper 194
  - Proposed bill 197
  - Future work 197

II. Report of Julian Thornley, resident engineer, in charge of reconnaissance, northern division 201

III. Report of Albert H. Perkins, resident engineer, in charge of surveys and reconnaissance, eastern division 265

IV. Report of Erwin E. Haslam, resident engineer, in charge of surveys on Raquette river, northern division 289

V. Report of Charles T. Rhodes, resident engineer, in charge of surveys and reconnaissance, western division 311

APPENDICES.

Appendix A: Report of Clermont C. Covert, district engineer, U. S. Geological Survey, on co-operative stream gaging 331
B: Decisions of the Commission on water supply applications. 381
C: Laws governing operations of State Water Supply Commission 437
D: Rules governing water supply applications 459
E: Financial statements 465

FIFTH ANNUAL REPORT.

ALBANY, N. Y., *February* 1, 1910.

To the Legislature:

The State Water Supply Commission, pursuant to the provisions of Article 2 of the State Boards and Commissions Law, as amended by Chapters 284 and 464 of the Laws of 1909, respectfully submits herewith its Fifth Annual Report. Accompanying this report, as Part III thereof, will be found the summary report of the Commission on its preliminary surveys and investigations for the development of the water powers of the State under State ownership and control, as submitted to the Governor on January 31, 1910, under the provisions of Chapter 569 of the Laws of 1907.

The conservation of natural resources is perhaps the most important public problem confronting the American people. The necessity for protecting and preserving the physical foundations of our prosperity has been forcibly brought to public attention in every section of the country. No other form of governmental activity has won such instantaneous and unanimous approval among all classes of opinion as has the patriotic effort of the Federal government to further the general welfare by insisting on the protection and proper use of our forests, minerals, lands and waters in the public interest.

Now that all sections of the country have been awakened, and many states are actively undertaking practical steps in the conservation program, New York may recall with satisfaction her record of first achievement in this field where so many of her sister commonwealths are following her lead. As early as 1885, New York led the way in the establishment of state forest preserves and inaugurated as a state policy the protection of her forests for the health and recreation of the people and the preservation of the sources of water supply. The same leadership has been continued in the state control of waters by the statute creating this Commission and investing it with its present wide range of jurisdiction over the water resources of the state. Since water is now widely recognized as the most valuable economic mineral of the earth and the importance of measures of public control to secure the full benefit of hydraulic resources to the people is realized, a brief summary of New York's pioneer water laws is pertinent, particularly as they provide the statutory background of this report.

The Legislature of 1905, in establishing, by Chapter 723 of the laws of that year, the New York State Water Supply Commission as now constituted, set a precedent in the state control of the distribution of waters among its municipalities, which has been followed by several other states. The act creating the Commission, which became law June 3, 1905, provided that no municipal corporation or other civil division of the State should thereafter have "power to acquire, take or condemn lands for any new or additional sources of water supply until it has first submitted the maps and profiles therefor to said Commission as hereinafter provided and until said Commission shall have approved the same." To secure this object of equitable control of the use of waters for municipal purposes, a permanent state commission consisting of five members was created, the commissioners to be appointed by the Governor by and with the consent of the Senate for terms of five years each.

A year's experience with the new law demonstrated a number of details in which it might be improved and the Legislature of 1906 by Chapter 415 of the laws of that year, effected the most important of these changes by including in the jurisdiction of the Commission private water companies and individuals proposing to supply water to municipalities.

After the State Water Supply Commission had exercised for a year this quasi-judicial authority over the distribution of the sources of public water supply, its powers were extended in a different direction by Chapter 418 of the laws of 1906, which devolved upon it the jurisdiction previously exercised by the River Improvement Commission as created by Chapter 734 of the Laws of 1904. This jurisdiction consists in the authority and duty, upon petition, to prepare plans for the improvement, by straightening, dredging and other means, of the channel of any water course of which the restricted, unrestricted or irregular flow is shown to be detrimental to public health and safety.

In the exercise of this new authority the Commission came into intimate relations with the subject of water storage, which had for many years been a matter of serious import in its relation to the State forests. Several previous investigations of the possibility and advisability of the State creating storage reservoirs to conserve the flow of streams for the benefit of navigation, the prevention of floods and the improvement of water powers had been made without a large degree of definite progress. Governor Hughes, therefore, in his message to the Legislature on January 2, 1907, emphasized the need of a more comprehensive plan of administration of the water power resources of the State which should embrace "in a clearly defined way the matter of water storage and the use of water courses for purposes of power. * * * The entire question of the relation of the State to its waters," he said, "demands more careful attention than it has hitherto received in order that there may be an adequate scheme of just regulation for the public benefit." Thereafter, as the first step looking toward the adoption of such a scheme, the Legislature passed the so-called Fuller bill, which was approved by the Governor July 12, 1907, and became Chapter 569 of the Laws of 1907. This law directed the State Water Supply Commission to make a critical inventory of the water power resources of New York and work out a comprehensive scheme of development under public control. The emphasis with which the principle of the public interest in the water powers of the State is asserted in this law is evident in its title, which directs the Commission "to devise plans for the progressive development of the water powers of the State for the public use under State ownership and control."

It will be seen that the several statutes above reviewed confer on the Commission a wide range of authority over the waters of the State. In interpreting these laws, therefore, the Commission has felt the responsibility thus laid upon it of suggesting a comprehensive plan and policy of the State for the conservation of its extensive water resources, however used. It has especially appreciated the importance of attempting to reconcile differing opinions on the subject of water storage, in an endeavor to secure a plan of state development, which, in correcting a serious economic deficiency in the public policy of New York, should give careful consideration to incidental benefits in the prevention of floods, the improvement of navigation, and the maintenance of the beautiful lakes of the forest parks with all their natural scenic and health-giving qualities, and should also result in the creation of attractive artificial bodies of water where in many places, swamps and inaccessible low lands now forbid all use or enjoyment. Thus only, the Commission believes, and only under such wise and progressive measures of State control, can the public interest in the waters of the State be thoroughly protected and furthered in full accordance with the modern trend of sentiment for the conservation of natural resources.

In the consolidation of New York statutes adopted by the Legislature of 1909, the laws relating to water supply and river improvement were combined in Article 2 of the State Boards and Commissions Law. In this consolidation the special act directing the water power investigations, because of its preliminary and temporary character, was not included. Subsequently in the session of 1909, the river improvement law received an important modification in substance by the enactment of Chapter 464 of the Laws of 1909. Chapter 284 of the same session also extended the River Improvement jurisdiction of the Commission to cases where the expense should be borne by local or private parties interested. The effect of these changes is discussed hereafter and the law itself together with all the statutes referred to above will be found in full in Appendix C.

The arrangement of this report follows the threefold nature of the Commission's statutory jurisdiction. Of its three parts the first deals with the applications for new or additional sources of municipal water supply during the past year, the second with the year's progress under the river improvement laws, and the third with the surveys and the plan now proposed by the Commission, after three seasons of investigations, for development of water power under state control.

PART I.

MUNICIPAL WATER SUPPLY.

PART I.

MUNICIPAL WATER SUPPLY.

During the twelve months since February 1, 1909, a greater number of applications for the approval of plans for new or additional municipal water supplies have been received and passed upon than in any preceding year of the Commission's work. Many of these have been made by the smaller villages. In examining their plans at public hearings and with the careful criticism of its Consulting Engineer, who passes upon the technical features of every application, the Commission has been able in many cases to bring its experience and advice to the effective assistance of these communities, in their undertaking of the most commendable of public enterprises, a publicly owned system of providing an abundance of pure water for their inhabitants.

Following is a list of the applications made to the Commission during the past year:

No.	Applicant.	Date of Filing.
49	City of Glens Falls	March 6, 1909.
50	City of New York-Nassau County Sources.	March 12, 1909.
51	Village of Bainbridge (second application)	March 16, 1909.
52	Fultonville Water Company	March 17, 1909.
53	Village of West Carthage	April 7, 1909.
54	Rensselaer Water Company	April 12, 1909.
55	City of Niagara Falls	April 20, 1909.
56	Village of Webster (amended application).	May 5, 1909.
57	Village of Canajoharie	June 1, 1909.
58	Village of Croghan	June 17, 1909.
59	Village of Mechanicville	June 22, 1909.
60	Central Bridge Water Company	July 2, 1909.
61	Whitney's Point Water Company	July 8, 1909.
62	Water District of Town of Petersburg	July 15, 1909.
63	Village of Livonia	July 16, 1909.
64	Village of Mount Morris	Aug. 2, 1909.

No.	Applicant.	Date of Filing.	
65	Village of Painted Post	Aug.	18, 1909.
66	Village of Farmingdale	Sept.	22, 1909.
67	City of New York (Modification of Catskill aqueduct)	Dec.	16, 1909.
68	Village of Barker	Jan.	11, 1910.
69	Jamaica Water Supply Company	Jan.	13, 1910.

Of these applications the following were approved, after examination of plans and hearings, practically without modification and on the dates indicated:

No.	Applicant.	Approved.	
49	City of Glens Falls	April	21, 1909.
50	City of New York	May	15, 1909.
51	Village of Bainbridge (second application)	Aug.	18, 1909.
53	Village of West Carthage	April	22, 1909.
54	Rensselaer Water Company	April	21, 1909.
55	City of Niagara Falls	July	14, 1909.
56	Village of Webster (amended application)	June	15, 1909.
58	Village of Croghan	Sept.	22, 1909.
59	Village of Mechanicville	July	13, 1909.
60	Central Bridge Water Company	July	29, 1909.
61	Whitney's Point Water Company	July	30, 1909.
62	Petersburg Water District	Oct.	14, 1909.
63	Village of Livonia	Oct.	21, 1909.
65	Village of Painted Post	Sept.	3, 1909.

The application of the Fultonville Water Company (No. 52) related to practically the same source of supply and in large part to the same consumers as that of the village of Canajoharie (No. 57) and since the company appeared as the principal objector in the proceedings on the application of said village, it has not asked for a hearing on its own application. A number of hearings have been held in the Canajoharie case which is still pending.

The application of the village of Mount Morris (No. 64) has been temporarily suspended during investigations for a more satisfactory quality of water.

In the matter of the application of the village of Farmingdale (No. 66) an agreement was reached between the village and the principal objector, the Nassau County Water Company, for the purchase by the applicant of the company's plant. Proceedings have accordingly been discontinued as the courts have held that no application to the State Water Supply Commission is necessary when a village merely acquires the property and rights of the private company which has previously supplied it with water.

Application No. 50 made by the city of New York in connection with its pipe line through Nassau county involved interesting questions of the construction of the State Water Supply law and the application of the principle of indirect damages. The decision of the Commission granting the application, which was filed on May 15, 1909, binds the city to equitable agreements with the villages through which the pipe line is to pass, and to the same practice in the matter of settlement of indirect damages which was insisted on by the Commission in granting the first application of the city for watersheds in the Catskill mountains.

At the time of the last report, February 1, 1909, five applications, as follows, were pending before the Commission:

No. 35 Village of Bainbridge.
No. 38 Palenville Water District.
No. 40 City of New York (Suffolk county sources).
No. 44 Village of Shortsville.
No. 48 Village of White Plains.

Of these the fourth (No. 44), was granted on February 6, 1909 and the second (No. 38), for reasons unknown to the Commission has not been pressed. The village of Bainbridge reconsidered its plans as first filed and made a second application on March 10, 1909 (No. 51), which after three hearings and further modification was approved as indicated above. The application of the city of New York for new sources in Suffolk county is still before the Commission, the proceedings having been postponed from time to time, at the request of all parties concerned. On the application of New York city for the modification of the plans of the Catskill aqueduct with reference to the method of delivering water to the several boroughs (No. 67), one hearing has been held, and proceedings are to be continued on February 10, 1910. This application was filed under the provision of chapter 724 of the Laws of 1905, which requires every modification of the plan of the Catskill aqueduct to be submitted to and approved by the State Commission in the same manner as the original project. The application of the village of White Plains, after many hearings had been held, was granted on November 30, 1909.

There are, therefore, pending before the Commission at the present time the following applications:

No. 40 City of New York (Suffolk county).
No. 57 Village of Canajoharie.
No. 64 Village of Mount Morris.
No. 67 City of New York (Modification of Catskill aqueduct).
No. 68 Village of Barker.
No. 69 Jamaica Water Supply Company.

Hearings on the last two applications, recently filed, are scheduled for the first week in February.

The decisions of the Commission in all cases which have been closed during the year will be found in appendix B.

STATISTICS OF SYSTEMS APPROVED.

During the past year a circular inquiry has been made among all the municipalities whose applications for new or additional sources of water supply have been approved since the establishment of the State Commission. The object has been to ascertain whether the system was constructed as approved, what changes in the plans, if any, were made and other details as to the progress of the work and the satisfaction given the community. A full report on the result of this inquiry is made by the Consulting Engineer of the Commission at page 133 below.

PART II.

REPORT ON RIVER IMPROVEMENT.

PART II.

RIVER IMPROVEMENT.

During the year covered by this report the river improvement law has been the subject of further consideration at the hands of the Legislature in the effort to provide a workable plan and a stronger basis of security for the bonds issued to defray the cost of each improvement. It is hoped that this object has now been secured by the enactment of chapter 464 of the laws of 1909, which, taken in connection with the decision of the Court of Appeals in June, 1908, upholding the constitutionality of the law, should insure its practical and unimpeded working in all cases. This result is the more to be desired since, in the opinion of the Commission, it should afford a much needed means of relief from floods on streams where there can be no question of power developments. Thus even after the State adopts a general plan of water storage and power development which incidentally will mitigate or prevent flood overflows on all streams where the new law is made operative, there will still remain, in the older river improvement law, a satisfactory method of dealing with important streams where the injurious effect on the public health and safety from excessive or restricted flow is the only consideration involved.

Since the amendment of the statute the Commission has received a number of applications for the improvement of the Hudson river, and has prosecuted with all possible dispatch the supplementary surveys and investigations necessary to bring into full accord with the amended law the two proceedings previously before it, namely, the improvement of the Canaseraga creek from Dansville to Mount Morris, in Livingston county, and the improvement of the Genesee river from Mount Morris to Rochester, in Livingston and Monroe counties.

This branch of the Commission's jurisdiction was extended into a supplementary field by chapter 284 of the laws of 1909, which gives the Commission authority to plan and execute river improvement projects in any case where a village shall petition for such improvement on account of its benefit to local health and safety and shall guarantee that the cost of the entire work will be met locally.

The matters above summarized are more fully discussed in the following pages.

AMENDMENT OF THE LAW TO PROVIDE FOR RIVER IMPROVEMENT DISTRICTS.

The Legislature of 1909, after consolidating the river improvement law with the statutes relating to water supply, in Article 2 of the State Boards and Commissions Law, subsequently amended the same by the passage of chapter 464 of the laws of 1909, above referred to. This amendment relates principally to the procedure in assessing the cost of river improvements on the lands and properties benefited, and to the issue of bonds and certificates by the Commission to temporarily provide for the expenditures on such improvements.

As has been set forth in previous reports, the Commission had found it impossible to market its bonds for the Canaseraga improvement because of the objection that they were payable from assessments upon the several single pieces of property improved, and that there was, under the original law, no municipality or civil tax district of the State liable for the bond issue. For this reason it was alleged that no certain and adequate security for the bonds was provided. Even in its decision upholding the constitutionality of the law, the Court of Appeals had accurately characterized the fundamental difficulty in pointing out that the law " nowhere assumes to pledge the credit of the State or any political subdivision thereof for the payment of compensation to the land owner. We can discover no language in the act which can be construed to have any such effect nor indeed is it easy to perceive what security is afforded for the payment of the bonds or the certificates of indebtedness which the State Water Supply Commission is authorized to issue except the proceeds of the assessments if they shall be collected." After the failure of two bond sales in the matter of the Canaseraga creek improvement, the Commission came to feel that the statute in its original form was unworkable and all progress on the Canaseraga improvement was necessarily suspended until the matter could be referred to the Legislature. The passage of the act above referred to was the Legislature's answer to the recommendations of the Commission.

The essential change made by this amendment is the provision for the creation for each improvement project of a civil division or tax district of the State to be known as a river improvement district. Under the amended law the preliminary procedure before the Commission is left unchanged and consists as before of the following steps:

1. Filing of the petition for the improvement.
2. Determination by the Commission whether the improvement is of sufficient importance to the public health and safety to warrant the interference of the State.
3. Preliminary surveys to determine the causes of the excessive, restricted or irregular flow.
4. Preparation of preliminary plans and specifications of the proposed works of improvement.
5. The statement and apportionment of benefit among the several counties, towns, cities, villages and property owners affected.
6. The public hearing, to be followed by a final order for the improvement, which in turn must be approved by the Legislature.

At this point of the procedure the amended law provides that the river improvement district shall be created in the following manner:

After the approval of the final order by the Legislature, the Commission shall determine what property other than the counties, towns, cities and villages is to be benefited, and shall cause a survey and map of such lands to be made, showing the name of the owner of each parcel as identified by a reference number on the map. This determination, after due opportunity for review and modification on public hearing, "shall conclusively fix and establish the lands and properties benefited by said improvement and the same, together with the counties, towns, cities and villages, included in said statement or list, shall constitute an improvement district." The total cost of the improvement as apportioned shall thereafter become a charge against the several counties, towns, cities or villages respectively and against such other lands as may be indicated by the foregoing procedure. The proportional share of the cost "collectively charged on the lands and properties within such improvement district as in this act provided, shall be a lien on all the lands and properties within such improvement district and shall be borne by and assessed and levied upon and collected from such lands and properties in the manner hereinafter provided."

The procedure under the new law in apportioning and collecting the assessments is as follows:

After an investigation the Commission is to issue a signed statement indicating the amount of benefit received by each parcel of land corresponding with the number on the survey and map provided for. After due opportunity for public hearing and review, these determinations of benefit with the consequent modifications, if any, shall become final. The Commission shall then annually transmit to the board of supervisors of each county included wholly or in part within such improvement district, a statement of the amount required to be paid by the lands and properties in said county, and thereupon the said board of supervisors shall cause the same to be levied and collected in the following manner:

The assessors of each town and city included in such improvement district are required to enter on their annual assessment roll, the description, by number corresponding with the number on the improvement map, of each parcel of land to be improved and the name of its owner, indicating the amount of benefit received by such parcel as determined by the Commission. The board of supervisors shall levy a corresponding annual tax on each parcel improved and this tax shall be collected in the same manner as general taxes and shall be a like lien as general taxes.

The proportional shares of the cost of the improvement, if any, chargeable to the State and the several municipalities shall be reported annually by the Commission to the Comptroller of the State, to the clerk of the board of supervisors of each county, to the clerk of each town, the mayor of each city and the president of each village affected and such proportional share of the cost shall be assessed, levied and collected by these several authorities in the same manner as general taxes.

It will be seen that the amended act in thus creating a definite civil tax district which is responsible for the cost of the improvement, provides as certain and absolute a basis for the ultimate payment of the river improvement bonds and certificates as is provided for in municipal obligations depending upon the assessment and collection of general taxes. The Commission hopes and believes that by this amendment the last difficulty in the way of the practical working of this important statute has been removed.

CANASERAGA CREEK IMPROVEMENT.

Under the provisions of the new law the Commission undertook at once the establishment of a river improvement district for the Canaseraga project. This involved the necessity of certain additional surveys. The original map of the Canaseraga creek improvement, as approved by the final order of the Commission, indicated the parcels of land to be taken in the execution of the improvement but did not show all the boundaries of the lands which would actually be improved. There was, therefore, nothing on the original map to show the exact amount of land covered by the severest floods. Since the establishment of the river improvement district under the amended law requires this information, a party of surveyors under the direction of Mr. Charles T. Rhodes, Resident Engineer, was sent into the Canaseraga valley to establish: (1) the boundaries of the improvement district, taking as a basis the flood levels of the highest floods, particularly that of 1902; (2) the division lines between the several properties affected by the improvement; (3) the area of each parcel of farm land inside the improvement district; (4) the character of this land, whether wooded, tillable or swampy, so that the amount of benefit to the owner might be closely determined.

The question arose almost immediately whether the statute was to be interpreted to include within the improvement district each entire parcel of land of which a part might be benefited or whether only that portion of each parcel within the flood line was meant to be included. It was finally decided that all property inside a boundary line fixed, in general, by the level of the flood of 1902, will be deemed to be included in the river improvement district and subject as such to the proportional assessment for benefit received in the abatement of floods. After this decision had been reached, the surveys were pushed rapidly to completion and a map was prepared, as required by the law, indicating by number each parcel of land to be improved and referring the same by its number to the owner thereof.

There is little need of adding to what the Commission has already said in its previous reports regarding the importance of the early execution of this project. A trip through the Canaseraga valley will convince even the most indifferent observer that the State has here a remarkable opportunity to exercise its larger powers of supervision and execution of a project for the public welfare, the financial burden of which the locality is ready to bear. The entire cost of the work, it should be remembered, is to be met by local assessments and the benefit will be felt most directly by the individual farms which will be relieved from their present burden. The rich soil of the Canaseraga bottom lands, especially at the upper end of the district sought to be improved, is particularly suited to nursery purposes. An especially favorable condition, in this respect, is the general freedom of the soil from rocks, enabling small seedling trees to be transplanted with a minimum of danger to their delicate roots. It is not surprising that the inhabitants of this region have long been disturbed by the fact that its productivity is so largely impaired by a condition which can be removed. Nor is it surprising that they are impatient at the unfortunate series of delays in the execution of the work, delays which this Commission has been powerless to prevent. It must be remembered that the river improvement act was placed on the statute books at a recent date and it has been necessary to subject it to the test of practical experience and consequent amendment before complete facility and smoothness of procedure could be attained.

GENESEE RIVER IMPROVEMENT.

During the past season the surveys of the Genesee river valley from Mount Morris to Rochester, begun in 1908 under a special appropriation, have been carried to completion. As the amendment of the law previously referred to had been made during the

Genesee River — Flood May 3, 1909.
View upstream from Jones' bridge.
More than 25,000 acres of farm land were submerged by this flood.

progress of this survey, care was taken to define for the Genesee river valley, a river improvement district similar to that now established for the Canaseraga creek under the new law.

The Genesee valley from Mount Morris to Rochester consists of generally low flat country through which the river winds in a long tortuous course. The rise of the land away from the river, on both sides, is much more gradual than is the case in the Canaseraga valley. Owing to the unconfined character of the river basin, the amount of territory covered by the larger floods of the Genesee is extremely great. Near Rochester, where tributaries flow in from the east and west, high water marks of Genesee floods have been found by the engineers as far away as four miles on one side of the main river and three miles on the other. During floods, therefore, the river expands to a distance of many miles. The Genesee valley above Mount Morris exhibits entirely different characteristics, the walls of the valley rising abruptly to form the famous gorge between Mount Morris and Portageville. Owing to this formation there is very little land of agricultural value in the immediate river basin between Portageville and Mount Morris and the floods cause slight damage. The proposed improvement district, which includes the lands to be benefited between Mount Morris and Rochester, is about forty miles long and extends, roughly speaking, from the line of the Erie railroad on the east side of the river, to that of the Pennsylvania railroad on the west, varying in width from half a mile to a mile and a half, and covers approximately 30,000 acres. This section of the Genesee valley includes some of the most fertile lands in the State and is especially adapted to the raising of grain and fruit, or rather, would be if the havoc caused by spring freshets could be prevented.

The improvement of the Genesee river so as to prevent flood damages to this farming territory presents altogether a different problem from the improvement of the Canaseraga creek. In the case of the Genesee, very little can be done by straightening and deepening the course of the stream. The only practical means of mitigating the floods is by the construction of a storage reservoir to hold back the excessive flow and let it out gradually after the peak of the flood has passed. The storage of the flood waters of the Genesee in sufficient volume to control all floods and relieve the valley permanently from their destructive effects can be accomplished under either of two alternative plans:

(1) By the great Portage reservoir proposed to be built under the plan of State development of water power, if special provision is made in the designs for the dam;

(2) The construction of a smaller reservoir with the dam near Mount Morris for the sole purpose of flood control and involving no power features.

The plan of controlling the Genesee floods in connection with the Portage power project by reserving the upper nineteen feet of the reservoir for the special storage of flood waters was described in the last annual report. Full details of the Portage project from the point of view of power development were presented in the first and second progress reports and are also summarized at page 74 of this volume. The reservation of nineteen feet depth over the fifteen square miles of the proposed Portage reservoir for the purpose of catching and holding the Genesee flood in effect superimposes a reservoir for flood control on a reservoir for power development. This nineteen feet of storage would provide a total capacity of six billion cubic feet, fully sufficient to effectively reduce the volume of the severest floods.

The same amount of storage to be used in the same way for the same purpose can be obtained by a dam at Mount Morris. As disclosed by the latest studies of the Commission, this reservoir would impound six billion cubic feet and would cover an area of 3½ square miles extending up-stream ten miles. It would cost approximately $1,200,000, while the additional nineteen feet on the dam and reservoir at Portage would hold as much water and cost only $550,000. The smaller reservoir would be of some service in increasing the amount of water available in the dry months at the power plants down the stream, and in the dilution of sewage in the river through the lower part of Rochester, but such effect would be entirely incidental, and a reservoir at this point cannot be compared with the greater project at Portageville as far as its power features are concerned. The smaller reservoir to be built under the river improvement law, is suggested only as an alternative sufficient to meet every purpose of flood control in case for any reason the Portage power reservoir is not built. If the larger project is carried out by the State under the combined plan suggested, there can be no need of the smaller reservoir. The Commission is unreservedly in favor of the larger combined project. It does not believe, however, that this project should be carried out under the river improvement law, involving as it does the development of power as the principal object. Under the plan embodied in the bill proposed by the Commission for the development of the water power resources of the State, the combined objects of flood prevention and power development on the Genesee, as well as on any other river of the State, can be accomplished under complete public ownership and control and a just revenue assured to the State from the power developed.

In these proposed improvements of the Genesee by the storage of its flood waters and of the Canaseraga creek by the straightening and deepening of its channel, the State has the opportunity to redeem the best lands of one of its most important river systems from the only serious menace to their productiveness. The two projects of improvement should be considered as partial and complementary phases of one great reclamation project. There is no doubt that under present conditions extremely disastrous floods occur in both the Genesee and Canaseraga valleys. They can and should be prevented by the execution of the Canaseraga project under the river improvement law, and the Portage reservoir project on the Genesee under the plan for the general state conservation of water power.

HUDSON RIVER IMPROVEMENT.

A number of petitions have recently been filed with the Commission praying for the improvement of the Hudson river under the amended river improvement act. These petitions, which were made by the cities of Albany, Troy, Watervliet and by associations of riparian owners, follow the outlines of similar petitions from similar sources filed in 1905 with the former River Improvement Commission and have, therefore, the effect of reviving the project for improving the flow of the Hudson river with reference to the present terms of the river improvement law. This commission inherited from the River Improvement Commission the duty of considering the original petitions for the Hudson river improvement, and, as stated in its Second Annual Report, at page 15, did not carry these proceedings to the point of public hearings, partly because the improvements prayed for would involve the construction of storage reservoirs on State lands, and partly because of the imperfect character of the law at the time, which left some doubt as to the time and manner of issuing the certificates authorized by the law to provide for carrying on river improvement work until bonds could be issued. The subsequent amendments to the law have cleared up this question, and, as the Commission reported at the time, it is possible to construct a number of reservoirs on the Hudson watershed which, while effecting the regulation of the flow of the river to a certain extent, will not flood State lands. Now that the proceeding has been initiated again in accordance with the present terms of the law, the Commission is called upon to determine to what extent the flow of the Hudson can and should be regulated under the provisions of this statute.

This entire question is closely involved with the State policy of water storage and power development as proposed by the Commission. In view of the recommendations that will be made for a systematic development of the water resources of the State for a public revenue, the Commission cannot at this time consider it either wise or practical to proceed according to the river improvement law for the regulation of the flow of this river. In view of the predominating importance of the Hudson as a water power stream and the unusual opportunities for regulating its flow on a large scale, the Commission believes that this work should be done by the State under its proposed conservation plan by which a revenue to the public will be assured from the improvement of water powers and at the same time the object of control of floods in the interest of the public health and safety fully attained.

LOCAL RIVER IMPROVEMENTS.

During the session of 1909, further river improvement jurisdiction was given to the Commission by the enactment of chapter 284 of the laws of 1909. By this act the State undertakes, through the State Water Supply Commission, the supervision and execution of the improvement of water courses at local expense. The board of trustees of any village is authorized by the act to present to the State Water Supply Commission "a petition requesting such Commission to assume jurisdiction of the construction of the proposed improvement to a water course adjacent to or in the vicinity of such village." The petition must state the character of the proposed improvement, the estimated cost and resulting benefit to the public health and safety. It is provided that if the Commission assumes jurisdiction, the money needed to defray the cost may be deposited to the order of the Commission in a national bank to be designated by it. The Commission upon receipt of such a petition shall make an investigation and determine whether the proposed improvement is of sufficient importance to the public health and safety to warrant it in assuming jurisdiction. If the Commission shall so determine, and if the deposit of money in amount equal to the estimated cost is made as provided for, the Commission shall cause such improvement to be made substantially in accordance with the plan proposed by the petition. Provision is made for the refund through the Court of Claims, of the expenses of such improvement, provided the State subsequently carries out a greater improvement involving and rendering useless the smaller one.

Under the provisions of this act the village of Tupper Lake filed on July 19, 1909, a petition asking for the improvement of the Raquette river by the construction of a dam at Setting Pole rapids about three miles below the village, where there exists, in a state of bad repair, a timber dam built by the State in 1865. By controlling the level of the water over the surface of Raquette pond and Big Tupper lake near the village, this dam would greatly improve present local conditions, covering up a considerable expanse of exposed flats and providing uninterrupted navigation from Tupper Lake Junction on the New York Central railroad to the village of Tupper Lake and thence to Big Tupper lake. It is also expected that the spring floods which now damage the portions of the villages of Faust and Tupper Lake near the lake shore, will be eliminated.

As provided by the law, the Commission immediately directed an investigation, through its resident engineer, into the advisability and probable cost of this improvement. Plans were made jointly by the Commission and the engineer of the village for a modern concrete dam equipped with gates for flood control. Subsequently a public hearing was held after due notice, at the village of Tupper Lake, and everyone concerned was given an opportunity to present his views regarding the proposed improvement. The plans were further examined and modified at the Albany office, and the work is ready to be commenced as soon as the money is raised and deposited to the order of the Commission as required by law.

NEEDED AMENDMENTS TO RIVER IMPROVEMENT ACT.

Each year a considerable number of bills are presented to the Legislature asking the aid of the State in the construction of dykes, dredging, widening and deepening of channels and the execution of other works of river improvement designed to create more healthful, sanitary and attractive conditions in the neighborhood of different cities and villages of the State. A number of such acts, passed by the Legislature of 1909, failed to receive the approval of the Governor. In vetoing these bills be explained in his accompanying memorandum that the many demands upon the State treasury made it impossible for him to authorize these measures. It was further pointed out by the Governor that the number of such requests for State appropriations for local river improvements indicated the necessity of providing a system whereby the just needs of these communities could be met without compelling the entire burden of such improvements to be borne by the State in those cases where a certain share is justly chargeable to the localities themselves. The Governor in closing his memorandum said: " The statute relating to river improvement, under the direction of the State Water Supply Commission, has been amended this year to make its plan more workable, and if anything more is needed to make it entirely adequate to the just necessities of further improvements in various parts of the State, it can readily be supplied by further amendment. We should thus have a method by which every exigency may be promptly considered, its requirements met, and the cost fairly apportioned. I hope that this subject will have early attention and that the whole matter will be put upon a proper basis."

It is clear to the Commission that the law in its present form does not give it the authority to execute all the improvements to which the Governor refers. Without doubt there are not a few cases of desirable improvements of this sort which could be brought under the scope of the river improvement act in its general form or in the special form covering improvements at local expense as provided by the recent amendment. There are many specific instances, however, calling for the construction of dikes, embankments and other improvements at particular points which perhaps would not fall clearly under any of the provisions of the law. To bring about a comprehensive control of this work by the State and to permit efficient and speedy relief in all cases, the Commission believes the law should be further amended as suggested by the Governor.

PART III

REPORT TO THE GOVERNOR

ON

WATER STORAGE AND POWER DEVELOPMENT

PURSUANT TO

CHAPTER 569, LAWS OF 1907

ALBANY, N. Y., *January* 31, 1910.

Hon. CHARLES E. HUGHES, *Governor, Executive Chamber, Albany, N. Y.:*

SIR.— Pursuant to the provisions of chapter 569 of the Laws of 1907, we have the honor to submit herewith the report of the State Water Supply Commission on its surveys, studies and plan for the general development of the water powers of the State for the public use and benefit.

Very respectfully,
HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS.

PART III

REPORT TO THE GOVERNOR ON WATER STORAGE AND POWER DEVELOPMENT

ALBANY, N. Y., *January* 31, 1910.

To the Governor:

The State Water Supply Commission, pursuant to the provisions of chapter 569 of the Laws of 1907, submits herewith a summary report of its surveys and investigations since July 12, 1907, looking toward a plan for "the progressive development of the water powers of the State, for the public use, under State ownership and control," and as required by section 10 of the act, accompanies this report with the draft of a bill* for a general law providing for carrying its plan and recommendations into effect.

In the enactment of the law directing these investigations, New York State, it is believed, took the leadership among all the American commonwealths in considering the means of conserving for the public benefit a natural resource which is now recognized as one of the principal factors of our welfare and progress. In order that the nature and history of this independent water conservation policy of New York State may be clearly understood, and that the purpose and place of the following report may be clear, this law, frequently referred to as the "Fuller Act," is here reproduced:

CHAP. 569, LAWS OF 1907.

AN ACT authorizing and directing the state water supply commission to devise plans for the progressive development of the water powers of the state for the public use under state ownership and control, and making an appropriation therefor.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. After the passage of this act, the state water supply commission is authorized and directed to devise plans for the progressive development of the water powers of the state under state ownership, control and maintenance for the public use and benefit and for the increase of the public revenue.

§ 2. The commission shall proceed at once to collect information relating to the water powers of the state and shall devise plans for the development of such water powers, as it deems available and may devise plans for the development of such other water powers as shall be brought to its attention by the mayor of any city, the president of any village, a supervisor of any town or the chairman of the board of supervisors of any county, by a petition verified and filed with it, praying for the development of such water powers. Each such petition shall show and set forth the public purposes to be served by the development therein proposed, and the commision may subpoena the petitioner or petitioners and such other persons as may be deemed desirable to appear before it and to testify under oath, which oath may be administered by any member of the commission, as to the statements made in the petition and as to other matters relating to the subject thereof.

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* See page 117.

§ 3. The commission shall present a report to the governor and the legislature on or before the first day of February, in the year nineteen hundred and eight, showing the progress made in its investigation, and shall, if practicable, complete its investigations to such extent as will enable it to devise a comprehensive and practical plan for the general development of the water powers of the state, and shall, if practicable, make the final report of such plan to the governor on the first day of February, in the year nineteen hundred and nine. The governor shall, if practicable, submit the said final report with his own recommendations, if any, relating thereto, to the legislature on or before the twentieth day of March, nineteen hundred and nine. In addition to the number provided by law, two thousand copies of the reports of the commission and the recommendations of the governor shall be printed.

§ 4. If any plan devised by the commission shall include the construction of a dam or dams upon any river or water course, the commission shall ascertain and report as nearly as practicable, the water storage capacity in cubic feet of the reservoir created by each such proposed dam, the recorded rain fall on the watershed above such proposed dam, and the maximum, minimum and average flow of water, per second, in cubic feet during each month in the year at the point where it is proposed to locate such dam. They shall, as nearly as practicable, estimate the water horse power which would be developed at such proposed dam, the probability of selling such water power, and the probable gross and net revenues from both direct and indirect sources which would be derived from the sale of such power at such proposed dam. It shall also state the relation of such gross and net revenues to the total cost of the construction, annual maintenance and depreciation, including the cost of necessary lands and riparian rights, and cost of acquiring them, and after deducting the annual cost of maintenance and depreciation, the net revenues which would be annually derived therefrom, and the length of time in which such net revenues would pay off the whole cost of construction lands and riparian rights with the interest thereon. The commission may include such other matters as it shall deem proper, in its report to the legislature.

§ 5. The reports of the commission shall specifically designate and recommend what work in their opinion, should be first undertaken and what work should be thereafter undertaken in the order of the importance thereof to the state.

§ 6. In order to determine the probable gross revenues, the rate of charge for the use of the water horse power under contract for sale shall be based upon the aggregate cost of the development, including the land and riparian rights of the single project, the cost of its superintendence, maintenance and depreciation, and the aggregate water horse power available from that single project, and such rate of charge shall be so adjusted that it will produce a net revenue sufficient to pay, in addition to all costs of suprintendence, maintenance and depreciation, the interest upon the bonds as the same shall become due and the principal of said bonds at their maturity.

§ 7. Surveys, plans, maps, calculations and estimates of cost may be made to determine the feasibility of any specific project for water-power development.

§ 8. All final surveys, plans, maps, calculations and estimates made pursuant to the provisions of this act shall be made with the same accuracy that would be requisite if the work and project so surveyed had been ordered to be done, and all surveys, plans, maps, calculations and estimates relating thereto shall be preserved for record and reference.

§ 9. The commission in its reports shall treat the general plan it shall devise and recommend for the development of the water power of the state as one state project and shall treat the specific and separate schemes of development as parts of the whole in order that the legislature and the people may have before them at once the most complete and comprehensive statement of the possibilities of the water power of the state and detailed as well as the aggregate cost of the development in such general plan proposed to be made.

§ 10. The commission in its final report shall also include the draft of a bill for a general law providing for carrying its recommendations into effect. It shall give such particular and detailed description of the several separate and specific schemes of development which are parts of the whole as may be necessary to designate clearly the work to be done, and such particulars as to each project shall be stated separately. Such bill shall include a financial plan providing for the issue of the bonds of the state in such amounts as may be required for paying the cost of the water power development to be made, how and when the bonds shall be issued and sold, the term for which they are to run, the rate of interest thereon, the annual tax to pay and sufficient to pay the interest thereon when due and the principal thereof when the same shall mature. The bill shall provide for the creation of a sinking fund into which the moneys received from the tax by such bill levied shall be paid, and into which the net revenues received from the sale of water power shall be paid, until the moneys in such sinking fund shall be sufficient to fully provide for the payment of the principal of all such bonds and the full interest thereon to the date of their maturity, and the tax shall then be discontinued under the provisions of article seven, section eleven, of the constitution. The bill shall provide for a separate issue of the bonds of the state for each separate scheme of development and for the submission of the bill to a vote of the people for their approval at a general election as provided in article seven, section four, of the constitution for the creation of a debt.

§ 11. The commission shall have power to appoint such engineers, assistant engineers and experts, fitted by experience, to advise the commission and to conduct under its direction the surveys, and the preparation of plans, maps, calculations and estimates as may be necesary within any appropriation which may be available therefor.

§ 12. The general plan which shall be devised by the commission under the provisions of this act, shall not include any of the streams and water courses which supply the canals of the state, excepting such streams and water courses as the state engineer and surveyor and the canal board, shall state in writing, will not, if used as above provided, substantially diminish the water supply of such canals or the navigability thereof, and provided that such plan shall not include any development of water power which would effect a diversion from any of the navigable waters of this state in sufficient quantity to interfere with the navigation of such rivers or water courses.

§ 13. The sum of thirty-five thousand dollars ($35,000), or so much thereof as may be necessary is ,hereby appropriated out of any funds in the treasury of the state, not otherwise appropriated, to carry out the provisions of this act, and the said moneys shall be paid by the treasurer on the warrant of the comptroller to the order of the state water supply commission when certified by that commission to be needed from time to time in carrying out the provisions of this act.

§ 14. This act shall take effect immediately.

I. GENERAL SUMMARY

The Commission, in the two progress reports already made to the Legislature under this law, has set forth fully the circumstances under which the statute was enacted. Now that the people of the entire country have awakened to the importance of conserving our natural resources and have come to a clearer realization of the fundamental importance of water in relation to present and future industrial, economic and social needs, the stand taken by the State of New York for public control of water power development must be a matter of pride to all its citizens. The passage of the Fuller bill in 1907 and the action of Governor Hughes in establishing the principle that payment should be made to the State for valuable water power franchises, marked one of the earliest efforts in this country toward State control of the development and use of water powers for the public benefit.

WATER RESOURCES OF NEW YORK.

It is appropriate that the State of New York should be the first to undertake a careful estimate of its water power resources with a view to a comprehensive public policy for their development. The Empire State is richly endowed with natural advantages, and has for years out-distanced all other States in the gross total of hydraulic power in use. The census taken by this Commission in

1908 exhibits a total installation, in the State, of 829,558 water horse-power. According to a table prepared by the Federal Census Bureau in the same year, California, which has lately displaced Maine as the nearest competing State, uses only 466,774 horse-power. The normal position of New York in the water power table has for years been found by practically doubling the figure of the next highest State. Even if the 200,000 horse-power generated in this State from Niagara Falls were deducted, the preponderance would still be very marked.

POSSIBLE DEVELOPMENT.

On the other hand, it has long been realized that if area and population as related to natural advantages are taken into account, New York has been greatly outdistanced by her New England neighbors, which, under favoring laws, have pushed the utilization of their water power resources well toward the physical limit. Yet no State has been more generously endowed with natural advantages favorable to a full utilization of its vast water power resources than New York. On its many rivers, especially those springing from the prolific water producing region of the Adirondacks, there are many advantageous sites for creating new developments and for increasing by artificial storage the capacity of existing power plants. The Commission estimates that no less than a million and a half horse-power can be ultimately developed on the interior streams of New York without counting the Niagara and St. Lawrence rivers. This great reserve of power, equal to nearly a third of all the water power in use in the United States at the present time, and sufficient to displace all the power now derived from coal for manufacturing purposes in New York State, and to provide it with all the motive energy it will need for many years to come, may, therefore, be said to be on deposit in the splendid natural water and forest resources of New York. To reach this great figure of 1,500,000 horse power development, there would be required the most thorough and scientific control of these forest and water resources by an authority with sufficient power and breadth of view to insure that every foot pound of commercially useful energy in the upland waters of every watershed shall be utilized for the general welfare through a systematic and economical plan. Such power and breadth of view inheres only in the State. In the endeavor to move toward this ideal solution of a great economic problem and to move in such a way that the gradually growing needs of the communities and industries of the State may be progressively met without impairing the ultimate completeness of the development, the Legislature called upon the State Water Supply Commission to make this study of the water power resources of the State and to suggest the outlines of an administrative plan, in the execution of which the State might hope eventually to attain its ideal.

PROVISIONS OF THE LAW.

The Fuller act includes three principal commands. The Commission is directed (1) to collect information relating to the water powers of the State, (2) to make plans for such specific developments as it deems available, and to continue its studies to such a point as will enable it (3) "to devise a comprehensive and practical plan for the general development of the waters powers of the State." Prescribing also the details of the inquiry the act directs specifically the kind of information to be obtained as to possible developments, and the drafting of a bill to provide for the administrative and financial features of a general development under public control. The act further prescribes the dates and manner of reporting results to the Governor and Legislature. From the frequent use therein of the words "if practicable," it is evident that the Legislature realized the great scope of the investigation and the probable limits of time and funds that must control the execution of its provisions. In the Fuller act no features stand forth more clearly than its thoroughly public nature and purpose, and the emphasis placed on an integral and comprehensive plan of development, in which every specific scheme shall stand as a part of the whole, and every section of the State be entitled to equal consideration.

LIMITATIONS OF INVESTIGATION.

The Commission is now prepared to render a summary account of its investigations since the passage of this act, setting forth all that has been undertaken and accomplished, together with the limitations which have operated to prevent further inquiries which might have been desirable. During the course of its water power studies, the Commission has come to an acute realization of the magnitude of the problem and of the vast amount of detail work required to make an accurate and complete survey of all the undeveloped power and storage possibilities in the State. It has been out of the question, with the limited funds available, to make in three years, with the minuteness of detail required by the provisions of the Fuller act, a survey of every possible reservoir and power site in the State of New York. To do this would require many years and the expenditure of hundreds of thousands of dollars. Believing that the expenditure of so much time and money merely as a preliminary to the adoption of a definite policy of development would be entirely unwarranted, the Commission has sought to make a sufficient number of detailed studies in different parts of the State to serve as typical examples of what can be done, while at the same time completing a more rapid examination of all the principal power streams. The Commission has given its principal attention to what it deems the chief object of the whole investigation, namely, the preparation of an administrative plan of development which is submitted herewith in the form of the draft of a bill as required by the Fuller act. This plan has been prepared in careful conformity with the spirit of the Fuller act, which calls for the impartial and comprehensive consideration of the needs of every section of the State. In the plan proposed all localities where power may be developed are placed on a par in their right to seek the aid of the State in an improvement which is beyond the scope of local authority. If thorough preliminary investigations have not been made in the locality asking for the improvement, the proposed bill contemplates that they shall be made forthwith under its procedure and the improvement subsequently carried out. There should, therefore, be no occasion for the feeling that any portion of the State has been neglected. The rivers which have been studied in detail were selected as types merely on the grounds of their importance and the limitation of funds. The fact that the Hudson, Genesee, Raquette and Delaware rivers were the first chosen for particular study does not by any means indicate that these rivers alone are to be considered in the general plan of development or even that they should necessarily be considered first. Every section of the State has an equal right to urge its own needs. The determination of priority of construction and the number of reservoirs in different parts of the State should be based only on the need of the improvement, the amount of funds available at the time, the extent of the benefits to accrue and the guarantee of the beneficiaries to pay therefor, which conditions necessarily fix the economic value and feasibility of the proposed improvement.

Having closely examined a number of the most favorable power opportunities, and having taken a general survey of the entire field, the Commission believes that sufficient data has now been gathered to warrant the immediate adoption by the State of a plan for water power conservation, and that the economic and social welfare of New York demands the early announcement of some definite policy under which the improvement of water power may be commenced and further detailed investigations made as rapidly as the needs of different sections shall require.

SUMMARY OF RESULTS.

The results of the three years' study of this subject by this commission may be briefly stated as follows:

(1) Following the general command of the act, the Commission has collected information relating to the water powers of the State, has made complete detailed plans for several great storage and power projects, and has brought its studies to such a point as now enable it to suggest " a comprehensive and practical plan for general development of the water powers of the State."

(2) The watersheds of the Hudson, Genesee and Raquette rivers have been thoroughly examined. Practically all storage opportunities on these watersheds have been investigated. Surveys, computations and estimates have been made to determine the possibility of complete regulation of flow.

(3) In the study of these streams four great reservoir projects of water storage for power development and flood control have been located, surveyed, mapped and described from the point of view of probable cost and benefits with all the detail required by the terms of the Fuller act. These projects are the Sacandaga

and the Schroon reservoirs on the Hudson drainage, the Portage reservoir on the Genesee, and the Tupper Lake reservoir on the Raquette.

(4) In addition special surveys of reservoir sites have been made at a number of points on these streams and on the Delaware The latter stream was thoroughly examined to locate the principal reservoir and power projects and to determine the conditions which must govern its development as an interstate river. Surveys made include those of the Cannonsville and Cochecton reservoir projects and the Lackawaxen and Mongaup power developments on the Delaware; the Little Tupper-Round Lake reservoir on the Raquette; the Hadley reservoir on the Hudson and the Lake Pleasant and Arietta Flow reservoirs on the Upper Sacandaga.

(5) Sufficient investigations have been made to establish beyond all doubt the right of the Oswego, Black and Oswegatchie watersheds to be counted with the Hudson, Genesee and Raquette as the six internal rivers of New York most important in point of view of water power developments and possibilities, and to show clearly the need of providing at the earliest practicable time for as complete a study of the first three streams as has already been made of the last three.

(6) In addition to the studies on the Hudson, Genesee, Raquette, Oswego, Black, Oswegatchie and Delaware rivers, thorough reconnaissance investigations have been made on the following streams and sufficient information obtained to determine the possibilities of development, and to locate the most available reservoir sites for further detailed study, namely: the Salmon river in Oswego county, the Salmon river in Franklin county, the Grass, St. Regis, Chateaugay, Chazy, Saranac, Ausable and Boquet. A more general reconnaissance has been made of the Susquehanna including the Chenango and Chemung, Allegany, Cattaraugus creek and the minor streams flowing into Lakes Erie and Ontario.

(7) In certain other cases as with the East and West Canada creeks in the Mohawk system, considerable study of existing maps and records in the office has indicated promising opportunities for power development and storage.

(8) In fixing upon the streams above named as the more important power rivers of the State, attention and study has been given to all available maps, reports and records, and many

inspections have been made in person by the Commission and its engineers. While the value of much of this work consists in establishing the certainty that no available opportunity has been overlooked, nevertheless, such an investigation was necessary in order to insure that every promising water power possibility was at least located and considered for further study.

(9) With the co-operation of the New York section of the United States Weather Bureau, a number of additional rainfall observation stations have been established at controlling points on the more important drainage areas, and all available rainfall data of the State have been collected, correlated and reduced to form for immediate and effective use.

(10) By an arrangement with the United States Geological Survey, a number of new stream-gaging stations have been established. All records have been co-ordinated and studied at the office of the Commission in order to determine accurately the rate and characteristics of flow of all the more important streams on which power studies have been made. Through the close and mutually helpful relations maintained with this Federal department, which, since the beginning of these studies, has established a division office at Albany, a still higher degree of completeness and accuracy of hydrographic data has been secured than was possible at the inception of the work.

(11) Statistics of all the developed water powers in the State have been gathered through personal visits by competent engineering employees; and details as to location, size and equipment of practically every water power plant in New York, even to the smallest, are on file in the department.

(12) Throughout all studies for the control of rivers for power development, there has been borne in mind not only the direct revenue to be obtained but the incidental benefits which would result from reservoir construction, namely: the mitigation of flood conditions, the protection and improvement of navigable channels, and the sanitary improvement of rivers by greater dilution of impurities. The opportunity has been taken to indicate the advantages of an integral plan of conservation of the water resources of the State for their fullest use to the people, whether in the form of public water supplies for cities and villages, artificial regulation

of stream flow for the prevention of floods, benefit to navigation, or the development of industries operated by water power.

(13) Realizing that one of the most serious problems involved in the adoption of a policy of water power development is the matter of reservoir construction on State forest lands, and the consequent necessity of a constitutional amendment, the Commission has made special surveys and estimates during the past season to determine the extent and location of lands in the State forest preserve which would be required for the most complete system of storage reservoirs which the State would ever find it desirable to construct.

(14) In all studies for storage reservoirs the Commission has taken every opportunity to emphasize its conviction that the most thorough precautions should be taken in all plans to insure such treatment of reservoir beds and shore lines as will secure results in keeping with the use of the forest lands of the state as public parks. Wherever the State shall construct reservoirs, whether within the forest preserve or not, it is essential that the various structures and the treatment of the territory involved should in every way be worthy of the State. The Commission is convinced as a result of its studies that dams and reservoirs can be so constructed as to be both safe and ornamental, and that in many cases the creation of large inland bodies of water will increase the scenic attractiveness of the region involved and improve the means of local transportation.

PLAN OF REPORT.

In the following pages the facts and findings thus summarized are more fully covered. There is first given a chronological review of the surveys and investigations made during the past three seasons, the results of which have been published in part in two successive progress reports which accompanied the third and fourth annual reports of the Commission, dated respectively February 1, 1908, and February 1, 1909.

On the basis of the surveys thus described there follows a general statement of the water power resources of New York and the opportunities for their development as shown by the studies of the Commission on the different watersheds.

Following this account of the extent and distribution of water power resources, the report will describe the plan of the Commission for a State policy of development, discussing the constitutional, administrative and financial features of the proposed legislation.

Throughout the present report, reference will be frequently made to the two progress reports, which contain the larger part of the detailed engineering information which has been gathered. It is intended that this report should be viewed chiefly as a summary presentation of the general results of the three years' work as the basis for considering a plan of State conservation of water resources.

II. REVIEW OF SURVEYS AND INVESTIGATIONS.

As soon as the Fuller act became a law on July 12, 1907, the Commission began work on the investigations intrusted to it. Believing that the scope and importance of this work demanded the highest technical ability available, the Commission secured the services of John R. Freeman, one of the most eminent hydraulic engineers in the country, to whom was delegated full authority to organize the engineering investigation and plan the details of the first season's surveys. The Commission concurred heartily in the position taken by Mr. Freeman that in view of the limited funds available and the short time remaining for field work before cold weather, it was advisable to select one or two large and promising opportunities for water storage and power development, and to study them as thoroughly as possible as examples of what might be accomplished under a public policy, rather than to dissipate the first appropriation in a cursory and inconclusive reconnaissance of the entire State. After thorough examination of maps and previous reports, and following personal inspections by the Commission and its engineers, the reservoir sites selected for the first studies were one on the Sacandaga river near its confluence with the Hudson, some fifty miles north of Albany, and the other on the Genesee river at Portageville, about fifty miles south of Rochester.

In pursuance of the plan adopted, surveying parties were organized as rapidly as the conditions of employment would permit and sent into the field at the two points selected. The advent of winter found the two undertakings in large part completed.

SACANDAGA SURVEYS — 1907.

The field work on the Sacandaga river was taken up by a force consisting of four parties for topographical surveys and one party for precise levels. On the basis of this survey, and other available data, maps were prepared during the fall and early winter showing nearly the entire margin of the reservoir and the location of each piece of property and practically every house as affected by flow lines at various elevations. The volumes of the reservoir were computed for the several flow lines studied, and alternative sites for the proposed dam near the village of Conklingville were surveyed and mapped. Further investigations determined the controlling factors for the location of a hydraulic tunnel, three miles in length, and a power house at that distance below the dam. Borings to reveal the character of the foundation for the dam were carried to such a point as to indicate that a large earthen structure would be most feasible. Substantially all the houses within the limits of the reservoir were examined, measured in outline, and their value, together with that of adjacent lands, liberally estimated. Trips of inspection were made throughout the watershed to determine its character and reliability as a water-bearing region.

GENESEE SURVEYS — 1907.

Meanwhile, the Commission had considered the requests of officials, associations and citizens of Monroe county for an investigation of the storage and power possibilities on the Genesee river. The preliminary examination of the opportunities for the construction of a great reservoir at Portageville convinced the Commission that this was one of the best development opportunities in the State. The Genesee was accordingly selected as the second river for study during the first season. Preparations were made to undertake a topographical survey of the reservoir basin and parties were put in the field. Maps of the land to be flowed, studies for the dam, hydraulic tunnel, alternative power house sites and accessories in connection with this development, were made, similar to those for the Sacandaga reservoir. Special care was taken to examine by means of test borings the geological formation of the thinnest portion of the natural rim of the reservoir basin. A principal object in all the studies on the Genesee was so to plan the development as to avoid any detrimental effect on the scenery of Letchworth Park, beyond the southern limits of which the dam was at first proposed to be located.

RAINFALL AND STREAM FLOW STUDIES — 1907.

Accurate measurements of precipitation and run-off to determine the water yield of a given territory are the indispensable preliminaries to all studies of regulation by water storage, and constitute the foundation of the entire structure of computations and estimates which determine in every case to what extent the construction of reservoirs can be justified on engineering and economic grounds. Realizing this fact the Commission and its engineers, immediately on taking up the work, proceeded to collect and coordinate all the existing rainfall and stream flow data of the State, and to extend the work of gagings wherever possible. In this work advantage was taken of all means of co-operation with the existing scientific agencies, namely, the United States Weather Bureau, through the office of the New York section at Ithaca, and the United States Geological Survey. By arrangement with these departments a number of additional rain-gaging stations were established in the Adirondacks, and two series of special comparisons instituted between the type of rain-gage formerly in use and the more modern kind, with a view to determining the necessary factor of correction, if any, for the records of earlier years. The average rainfall for both the upper Hudson and Genesee regions was determined and charts showing the same were prepared. A review of all published gagings on the upper Hudson was made and a series of daily river height observations instituted at seven new points on the Hudson watershed.

On the basis of these observations, fortunately begun before the close of an unusually severe drought, estimates of the amount of storage required for permanently regulating the flow of the Hudson, Sacandaga and Genesee were made with all the precision necessary for thorough and scientific water power studies.

FIRST PROGRESS REPORT.

The information obtained during the first season, and the results and deductions reached therefrom were published in a first progress report, accompanying the Third Annual Report of the Commission, transmitted to the Legislature February 1, 1908, and subsequently reprinted. This report contained Mr. Freeman's comprehensive and thorough-going account of the inception of the investigation and the details of the great Sacandaga and Portage reservoirs, with his preliminary estimate of their hydraulic and economic effects when constructed.

Upon receiving this progress report, the Legislature, again supported by the recommendations of the Governor, signified its approval of the purpose and plan of the investigation, by making substantial appropriations for its continuance during the following season.

SEASON OF 1908.

As soon as the enactment of the appropriation laws and the approach of spring made it possible, the Commission organized its investigations for the summer season of 1908 on a larger scale than in the previous year. It determined to complete the details of the Sacandaga and Genesee projects to such a point that they might be presented to the Legislature in the form of construction propositions, and to continue investigations on the Upper Sacandaga by surveys of reservoir sites at Lakes Pleasant and Piseco. It was further planned to conclude the study of the Hudson river by detailed surveys of storage possibilities on another important tributary, the Schroon river, similar to those already made on the Sacandaga, and by careful examination of the upper Hudson and its smaller tributaries. In addition, the Raquette river was selected for thorough study on account of its important developed and undeveloped powers. Extensive surveys and reconnaissance with a considerable force were also planned on the Delaware river.

To carry out these surveys and studies the Commission established four general engineering divisions of the State and placed the work in each division in charge of an experienced engineer. The general control over the engineering studies was placed jointly in the hands of Walter McCulloh, the permanent consulting engineer of the Commission, and Horace Ropes, special deputy engineer, who had directed the Sacandaga surveys during the previous season. The services of John R. Freeman were again secured as special consulting engineer, to make a critical review of the season's work.

EASTERN DIVISION — 1908.

In the early part of the season the special deputy engineer made extensive reconnaissances of the entire Hudson watershed including the Sacandaga, Schroon and Upper Hudson divisions in order to prepare the way for more complete special surveys. In this manner an inspection was made of the principal lakes and ponds and storage opportunities in the Newcomb and Tahawus regions above Ords Falls, and portions of the Boreas, Indian and Cedar rivers were carefully looked over. The Schroon and nearly all its principal tributaries and lakes were examined preparatory to the surveys to be made.

A force was early sent into the field to complete the topographical survey of the Sacandaga reservoir at several points where it had been impossible to cover the ground before the beginning of the previous winter season. A revision of the surveys for the relocation of a portion of the Fonda, Johnstown and Gloversville railroad was made and further study made of the Conklingville dam site.

On the Upper Sacandaga skeleton surveys were made of Lake Piseco and considerable topographic work was done on the Arietta flow in order to check and supplement the maps of this basin made in 1902 for the Water Storage Commission.

After the completion of the Sacandaga work the force was transferred to the Schroon river where surveys were made of dam sites at the outlets of Brant and Paradox lakes and for three sites on the Schroon river below Schroon lake. Topographic surveys were extended along the shores of Brant and Schroon lakes with special attention to details of property to be taken in the vicinity of villages. For want of time it was necessary to postpone closer examination of the wilder portions of the shore line and the surveys around Paradox lake until the next season. A sufficient degree of progress on the Schroon project had been made at the end of the season, however, to enable the Commission to report the main features of two alternative schemes of development, one consisting of a single great reservoir governed by a dam at Tumblehead Falls, and another involving a lower dam at this point supplemented by a series of smaller reservoirs throughout the Schroon drainage area. Time did not suffice to complete the test borings begun at the Tumblehead Falls dam site.

In the upper Hudson proper, a topographic survey of a reservoir basin above Hadley which had been begun during the previous season, was carried to practical completion.

NORTHERN DIVISION — 1908.

Early in the season a reconnaissance of the Raquette river watershed including all of the principal lakes was completed from Norwood to Raquette lake, the source of the river. A general topographical survey was subsequently made of twenty-five square miles of territory included in the most important reservoir site on the Raquette river watershed, namely, the region around Big Tupper lake. Three alternative dam sites near Tupper Lake village were studied with reference to engineering and economic considerations. Sites for dams at the outlet of Round lake and at the head of Raquette falls were also studied and a topographic survey was made of the east bank of the river in connection with a study for the development of Raquette falls. The slope of the river was determined by a line of levels from the head of Raquette falls to South Colton and cross sections taken at each available dam site. With an early start giving opportunity to devote the entire season to the work, it was possible to complete a general study of the entire Raquette river drainage basin.

WESTERN DIVISION — 1908.

The study of the Genesee river from the combined viewpoints of power development and flood prevention was carried to a high degree of completion. Three field parties began work in May and finished the topographic survey of the basin of the proposed reservoir from the dam site at Portageville to the town of Caneadea, covering an area of about twenty square miles. A survey was made for the relocation of seventeen miles of the Pennsylvania railroad in such a way as to avoid crossing Letchworth park. Surveys and drill borings were also made along the line of the proposed power tunnel and at the alternative sites for the dam. Considerable further study was given to the question of the safety of this reservoir, in consideration of the criticism that had been made that the natural rim of the reservoir would not withstand the great pressure of the water. Alternative estimates and studies in full detail were also made to compare the cost and advisability of two possible locations for the dam, one as proposed during the previous year's work entirely outside the limits of Letchworth park, and the other involving the overflow of a narrow strip of park land along the shore of the river.

Upon the petition of the county of Monroe and the city of Rochester, under the River Improvement act and under the special appropriation made by the Legislature of 1908, a topographical survey of the Genesee valley from Mount Morris to Rochester was begun in October after the completion of the reservoir and power surveys above referred to. This work was to determine the location of the river in its winding course through the valley, and to fix the boundaries of the area which suffers from floods. The principal highway lines and the boundaries of towns and counties were also established and by the close of the season the work was well advanced.

SOUTHERN DIVISION — 1908.

In answer to numerous petitions and requests calling for an investigation of the Delaware river with a view to determining its power possibilities and at the same time mitigating the especially destructive floods on that river, the Commission undertook a comprehensive series of reconnaissances and surveys throughout the drainage basin of the Delaware in New York State. After a preliminary examination of the entire watershed several sites were selected for more detailed surveys at points which seemed to promise the best results. Near Cannonsville, on the west branch, a site for a reservoir capable of impounding 7,000,000,000 cubic feet of water was studied in detail. A number of studies were made at points farther down the river, where, with this storage, important power developments could be created. The profile of the river from Port Jervis to Walton was determined by a line of levels, and the steep portions where power developments are possible were thus located. Topographical surveys of power sites and basins for reservoirs at Cannonsville, Cochecton and Lackawaxen were made, and also surveys of a dam site at Mongaup and of the old Delaware & Hudson canal between Mongaup and Port Jervis.

HEADQUARTERS DIVISION — 1908.

A considerable force of engineering employees at the Albany office was engaged during the entire season in preparing and completing maps based on the field surveys, and making designs for typical power developments. The existing topographical maps of the State, as far as completed by the United States Geological Survey, were examined with great care to locate all important opportunities for power and storage projects. Promising reservoir sites were thus selected for further investigation and the profiles of several important rivers and their larger tributaries were determined. The watersheds of the main river systems and many of their subdivisions were delineated on these maps, which were used as a standard wherever available. By careful planimeter measurements the watershed areas were computed with a view to eliminating errors due to the use of less accurate maps in earlier reports of other authorities. As a part of this work all lakes and large ponds within the more important river basins were listed and their areas computed.

OFFICE AND HYDROGRAPHIC STUDIES — 1908.

The study of all the available rainfall records of the State was continued. Special rainfall maps were prepared for the Delaware, Raquette and Schroon basins to establish the relative water producing value of different parts of these watersheds.

The study of the stream discharge records of the State occupied a large portion of the time of the office force. By means of the mass curve method as developed by Mr. Freeman, an extended series of investigations was made of the volume and variations of flow on the several rivers, to determine the quantity of storage required to give different rates of regulated stream flow and the probable depletion of reservoirs month by month through a series of years. Mass curves showing these facts were prepared for different points on the Hudson, Genesee, Raquette, Delaware, Sacandaga, Schroon, Black and Oswego rivers, the West and East Canada creeks and a number of tributary streams.

Following the power development studies for the Sacandaga and Portage reservoirs prepared during the previous season, a full set of plans was now made at the office for the dam, intake, powerhouse and appurtenant works for a 32,000 continuous horse-power development at Colton on the Raquette river. Preliminary plans for dams and other structures were also made for the Cannonsville, Narrowsburg, Lackawaxen and Mongaup reservoirs on the Delaware river, the Tupper lake, Round pond, and Long Lake reservoirs on the Raquette river, the reservoirs at Lakes Pleasant and Piseco on the Sacandaga river and at Tumblehead falls on the Schroon river.

Estimates of the cost of all structures and the various items of reservoir construction as well as of the amount of available power were made at the office for all the different projects studied and the arrangements for the collection, preservation and indexing of all data obtained, were extended and perfected.

WATER POWER CENSUS — 1908.

In order to secure reliable data as to the total extent and local distribution of developed waters powers in the State, blanks were prepared for the collection of full statistical information regarding every such development. In order to make this inquiry more complete and accurate than could be done through correspondence, the Commission employed four qualified engineers to make a canvass of the entire State, stream by stream, visiting each development of importance and obtaining the desired information as to height of fall, extent of turbine installation and power output, kind of manufacture and other details including specially the number of months of the year during which the plant suffered from shortage of water. The canvass was completed with satisfactory results and supplemented by inquiries through the mails from minor water powers too small to warrant a personal visit. A map was subsequently prepared showing the location and comparative size of all water power installations in the State.

RECONNAISSANCES — 1908.

In addition to the extended preliminary examinations of regions where special surveys were undertaken, the Special Deputy Engineer made a personal examination of a number of watersheds of the State including the Allegany river, Lake Chautauqua, Lake George, Lake Oneida, Black river, Oswegatchie river and certain streams of minor importance in the southwestern section of the State.

SECOND PROGRESS REPORT.

The results of the investigations of the season of 1908 were embodied by the Commission in its extensive second progress report on water power development published with the Fourth Annual Report and transmitted to the Legislature February 1, 1909. This volume was accompanied by numerous illustrations of the work and also a separate portfolio of maps, charts and diagrams illustrating in full detail some of the more important features of the different developments recommended.

SEASON OF 1909.

The work of the two previous seasons had brought out clearly that one of the essential features of the summary report of the Commission under the provisions of the Fuller act must be as detailed and accurate an estimate as practicable of the amount of land owned by the State which would be needed for the construction of reservoirs for a complete system of water storage in the Adirondacks. The time left at the end of the previous season had also been insufficient for as thorough a study of the Schroon reservoir project as was desirable to have the completeness of the study compare favorably with that on the Sacandaga reservoir. While it had become clear in the course of the two seasons' investigations that the extension of detailed surveys to every river of the State would occupy many years and a very large expenditure, the Commission, nevertehless, felt that before the submission of its plans to the Governor, as thorough a preliminary examination as possible should be made on all noteworthy power streams in order that the best locations might be determined for further and more detailed study in the future. The annual message of the Governor to the Legislature of 1909 had reiterated with greater emphasis than ever, his firm conviction of the importance of the investigations of the Commission and the Legislature again responded with an appropriation sufficient to enable the Commission to undertake the preparation of its summary report along the lines just indicated.

RESERVOIR SURVEYS OF 1909.

A small force had been carried through the winter for the purpose of completing the mapping and recording of data obtained in the field during the previous season. As soon as the appropriation of 1909 became available in May, the surveying parties were selected and sent into the field to complete the work above outlined. An account of the personnel of the force and the organization and prosecution of the surveys will be found in the report of the engineer of the Commission, page 138 below.

The work accomplished in the Eastern Division consisted chiefly in the completion of topographic surveys on the east and north shores of Schroon lake and around Paradox lake. A further study was made of the territory at Tumblehead falls where a number of test borings were put down at the site of the dam. The parties were then transferred to the Sacandaga river where certain additional surveys were made in the valley for about four miles north of the village of Northville.

The work in the Northern Division aside from the investigations of State lands described below, included a topographical survey of the Little Tupper-Round Lake reservoir project, additional studies and estimates for alternative dam sites near Piercefield for the Tupper Lake project, and the hydrographic investigation of the Raquette river in connection with a dam at Setting Pole Rapids under the application of Tupper Lake village pursuant to chapter 284, Laws of 1909.

In the Western Division no additional surveys for water power development were found necessary, although the study of the Genesee river from the point of view of flood prevention was rounded out by the completion of the surveys from Mount Morris to Rochester under the River Improvement Law.

RECONNAISSANCES OF 1909.

In order to complete a general view of the water power possibilities of the State, the resident engineers in each division were instructed, upon the completion of the assigned topographic surveys, to make a reconnaissance of all streams in their territory which had not already been examined in the course of the work of previous seasons. In pursuance of the same object an expert engineer with the necessary assistants had been despatched early in the season to the northwestern section of the State with instructions to devote all his time to a reconnaissance of the Black, Oswegatchie, the two Salmon rivers, St. Regis, Grass and other rivers flowing into Lake Ontario and the St. Lawrence river. The importance of the Black river warranted the expenditure of nearly half the season on that watershed, but the possibilities of all these streams were closely determined and the best locations found for detailed surveys in the future. In a similar way the Ausable, Chateaugay, Saranac, Chazy and other streams of the northeastern portion of the State were examined by the Resident Engineer of the Eastern Division. The engineer of the Western Division, after the completion of river improvement surveys on the Genesee, made an inspection of power and storage opportunities on the streams of the western and southwestern parts of the State, including the Allegany, Chemung, Cattaraugus creek and smaller streams flowing into Lakes Erie and Ontario.

STATE LAND SURVEYS — 1909.

The plan of gathering the required information as to the amount of State lands needed for all reservoir projects, one of the main objects of the season's work, included the making of special surveys under the direction of each Resident Engineer in his own district. A large part of the season was, therefore, devoted to these surveys in the eastern and northern divisions. In connection with the reconnaissance of the streams in the northwestern section of the State, a careful determination was made of State lands involved in the projects outlined. No State lands are involved in possible developments in the western counties. The extent of forest preserve lands required on the watersheds of the Schroon, Sacandaga, Upper Hudson, Raquette, Black, Salmon, Oswegatchie, St. Regis, Grass, Saranac, Ausable and all other streams issuing from the Adirondack region has, as a result of the season's work, been determined.

OFFICE AND HYDROGRAPHIC STUDIES — 1909.

A sufficient force of office engineers, draftsmen and tracers has been maintained at the Albany headquarters of the Commission to carry on the compiling, classifying and filing of the data obtained in the field, and to compile and check the data of stream flow and rainfall obtained in co-operation with the United States Geological

Survey and the United States Water Bureau. Under the arrangements made this year with the United States Geological Survey much closer and more satisfactory relations have been established through the creation by the survey of a separate district in New York State with headquarters at Albany. In this manner, through the opportunity for frequent conference with the officers of the Geological Survey, the Commission has been able to obtain exactly the investigations and information most needed and with the highest possible degree of promptness and securacy. Through continuous examination and study of the records thus obtained, the engineering department has been able to bring its knowledge of rainfall and stream flow in New York State to a high degree of completeness and accuracy with respect to the particular problems under investigation.

III. OPPORTUNITIES FOR WATER STORAGE AND POWER DEVELOPMENT.

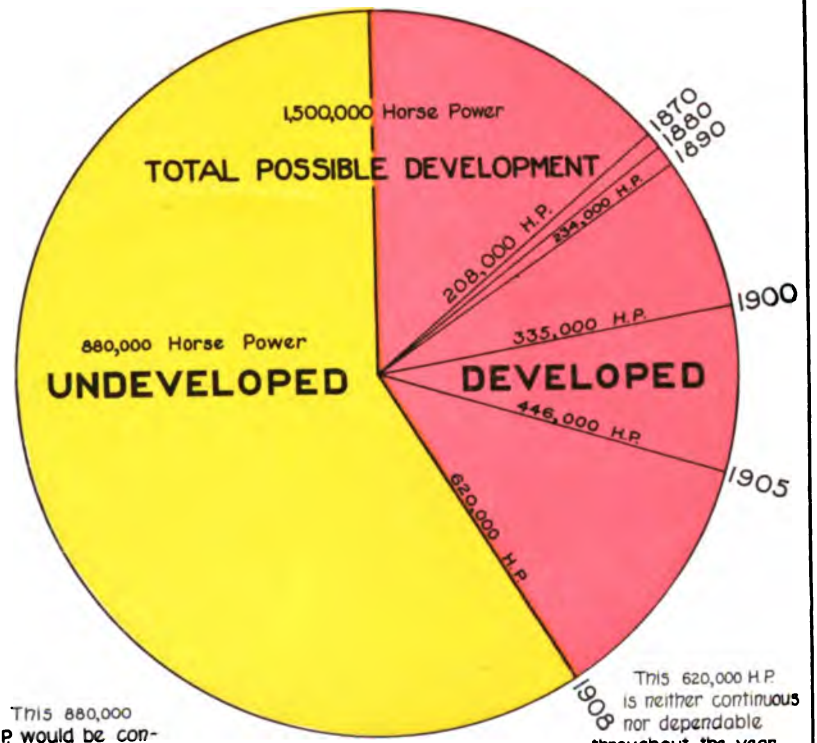
In the following pages a rapid survey will be made of the conditions disclosed by the past three seasons of study on the principal power streams of the State, and of the opportunities thereby located for water storage and power development under State ownership and control. The possibilities on each stream, which are but summarized here, have been treated with more detail in the previous reports of the Commission, or, in so far as the studies of the past season cover new territory or modify results previously obtained, in the engineering reports which accompany this volume. The amount of material which can be published, however, is necessarily restricted, and a great deal of data regarding the different projects is on record in the office of the Commission, which cannot be embodied in the form of printed reports. This is especially true of maps, plans, diagrams and graphic studies, of which a very great number have been prepared, although only sufficient have been published to serve as typical illustrations of the methods and results of the investigation. All data in the office has been systematically recorded, indexed, and prepared for ready use.

In the following account of the water power resources of the State, the subject will be taken up under topical headings of the several rivers, approximately in the order of their present importance as developed power centers. This order is not to be considered as necessarily suggestive of the order in which the State should undertake their future development, since a number of other considerations may properly enter into the determination of the relative importance of the several sections of the State as regards the first work of construction.

RELATION OF STORAGE RESERVOIRS TO POWER DEVELOPMENT.

Before discussing any opportunities for the development of our rivers, occasion may be taken to indicate why it has been necessary, in this and the earlier reports under the Fuller act, to place such emphasis on the great importance of artificial water storage as affecting modern water power development. This gen-

Plate 1



This 880,000
H.P. would be continuous 24 hour 7 day dependable water power without any auxiliary.

Above figures are exclusive of international Streams; Niagara and St. Lawrence Rivers.

This 620,000 H.P. is neither continuous nor dependable throughout the year. The deficiency is partially provided for by a considerable use of 124,000 H.P. steam auxiliary.

STATE WATER SUPPLY COMMISSION
OF
NEW YORK
GROWTH AND PRESENT DEVELOPMENT
OF
WATER POWER IN N.Y. STATE
COMPARED WITH
POSSIBLE DEVELOPMENT
BY MEANS OF
STATE WATER STORAGE RESERVOIRS.

JANUARY, 1910.

Walter McCulloch
CONSULTING ENGINEER.

eral subject, especially in its relation to the forests, is more fully considered later in this report. It is sufficient at this point to indicate that the regulation of stream flow is the indispensable condition of an ultimately complete development of water power resources, as well as the most available expedient in any immediate effort to increase the number and value of hydraulic power installations. It is a fact, too well known to need repetition, that the economic limit of profitable water power development without storage is a point not very far above the minimum flow of the stream. Any further installation is at the risk of frequent interruptions of power, unless the plant is equipped with expensive auxiliary power to supply the deficiency during the dry months when the flow of the stream is insufficient for the capacity of the water wheels. Such auxiliary installation may not be necessary when the manufacture is of such a nature as to permit accumulation of the product during the months of high flow, sufficient to supply the market during the months when the water-wheels cannot run. This method is in effect regulation by storage of product instead of by storage of water. It is possible only with the coarser grades of product such as those of the lumbering and wood pulp industries. It is impracticable in all the finer manufacturing processes where continuous and speedy output is demanded, and is of course altogether impossible in the production and marketing of electric current for transportation, lighting and other purposes, where the highest degree of continuity of power production, night and day, is demanded throughout the year. Such continuity is secured at most hydraulic plants under present conditions only by means of auxiliary power. To regulate the flow of a stream by water storage, therefore, makes it possible to supply water instead of other auxiliary power to the plant during the dry months, thus greatly increasing the water power capacity and lowering the cost of production. Where no auxiliary is in use, the additional power from water storage is clear gain.

The irregularity of the flow of all our streams is such that even a small degree of regulation will greatly improve present conditions and increase the river's power output to a large extent. While the complete utilization of all water power possibilities necessitates a practically complete artificial control of stream flow, every step toward such control brings its proportionate share of benefit. Under present conditions there are many plants near or below the margin of a living profit because of the unreliable flow of our rivers, and many inviting projects for new developments are worthless except on condition that the river be regulated.

The control of the flow of our rivers is, therefore, the first practical step in the development of our hydraulic power resources. As will be shown later it is a step peculiarly within the province of the State's efforts for the general welfare.

HUDSON RIVER.

The Hudson river, the most important internal power stream of the State, should, beyond all doubt, receive the first attention in any system of State conservation that may be adopted. On account of its size, the extensive population in its valley, its numerous developed industries and the nearness of its water power sites to a favorable market, the Hudson provides, with especial completeness, the economic conditions necessary for the execution by the State of a plan of storage regulation based on business principles.

The physical conditions on this watershed are equally favorable. The thorough study which has been given to the Hudson river discloses the fact that it is subject to extreme fluctuations between high and low water. At Mechanicville the daily discharge has been known to vary in the ratio of 100 to 1, from the flood of 1869, with its maximum recorded discharge of 70,000 cubic feet per second to the drought of 1908, when the flow of the river fell as low as 700 cubic feet per second. If the flow of the river for the twenty-year period from 1888 to 1907 had been reduced to perfect uniformity, the average rate of run-off at this point would have been 8,120 second-feet. If Spiers Falls be considered the "center of gravity" of the power district, and the point where the maintenance of a constant flow will bring the best average results, it is found that complete regulation of the river would require about 120,000,000,000 cubic feet of storage capacity, which would give, at this point, a minimum flow of 5,200 cubic feet per second. The attainment of this degree of regulation is, however, an academic ideal. The economic con-

siderations which will govern for as far in the future as we can see, would limit the extent of practical storage regulation to a point considerably short of this capacity and rate. Moreover, even if it were practicable and desirable, reservoir basins adequate for the storage of 120,000,000,000 cubic feet of water do not exist on the Hudson watershed. Investigations so far made show that 61,000,000,000 cubic feet is very nearly the maximum for which suitable storage basins can be found. This amount may, therefore, be considered as a practical figure, to be reached, perhaps, after many years, as the growth of population and industry creates an economic necessity for the more and more complete regulation of the stream. To store this water would require the construction of twenty or thirty reservoirs distributed through the three principal divisions of the watershed, namely, the Sacandaga, the Schroon and the Upper Hudson valleys. With such storage, the mean monthly discharge at Spiers Falls would never be less than 4,600 second-feet as compared with the figure of 684 second-feet in the exceptional drought of September, 1908. Considering the fact that each successive increment of storage can be shown by computation to produce a smaller increase in the average flow than the last preceding one, it seems clear that 61,000,000,000 cubic feet is probably the economic limit beyond which it will prove unprofitable to extend the construction of reservoirs even if sites could be found. Because the attainment of this high ideal of storage regulation seems necessarily a matter of the distant future, it should not, therefore, be assumed that immediate steps are not possible or profitable. The fact is that the first storage reservoirs constructed would yield greater immediate results in proportion to their capacity and would improve present water power conditions on the Hudson river in a remarkable degree. Each project can and should be separately and individually justified as a self-supporting business proposition under State ownership and control.

The two greatest storage projects on the Hudson river indicated by the studies of the Commission are first, the great reservoir on the Sacandaga at Conklingville, providing 29,000,000,000 of the 61,000,000,000 cubic feet of possible storage, and second, the proposed reservoir over the surface of Schroon, Brant and Paradox lakes which will store 16,000,000,000 cubic feet more. The remainder of the total practicable storage would have to be secured by a number of smaller reservoirs on the upper Hudson, including the enlargement of the present Indian Lake reservoir. In effecting the regulation of the Hudson, the Sacandaga and Schroon projects are from every point of view the most available and profitable for immediate construction. As between these two, the arguments for the Sacandaga as the first reservoir which should be built by the State seem, in the light of recent developments, to be unanswerable.

SACANDAGA PROJECT.

The proposed Sacandaga reservoir to be created by a dam at Conklingville has been fully described in the two progress reports of 1908 and 1909, and its effect in regulating the flow of the Hudson river, both with and without power development at the dam site, has been discussed therein. In view of the prime importance and typical significance of this project it will be useful, however, to summarize here its main features.

The Commission proposes the construction of a dam at Conklingville on the Sacandaga river, about fifty miles north of Albany and six miles above the confluence of the river with the Hudson, thereby creating a storage reservoir of 29,000,000,000 cubic feet capacity, and converting thirty miles of the present river valley into an artificial lake of the same area as Lake George.

The studies indicate that over the well-wooded watershed of the Sacandaga there is an average rainfall of forty-eight inches, which is the highest recorded rainfall on any portion of the Hudson drainage area. The monthly stream flow of the Sacandaga at Conklingville, based on our records of the past two years, varies from a maximum of 40,000 cubic feet per second to a minimum of 200 cubic feet per second. The reservoir site is fortunately so located and of such size that these irregularities of discharge can be practically eliminated and the flow reduced to almost absolute uniformity or manipulated in any desired manner.

The primary object in building this reservoir is to produce a revenue for the State by affording relief from low water conditions to power producers on the Hudson. The range of fluctuation on the Hudson at Mechanicville has been noted on page 64. Based on the thirteen-year record the range of the daily discharge at Spiers Falls, the "center of gravity" of the power district, is from 700 second-feet low water flow to 45,000 second-feet flood flow, with an average of 5,000 second-feet. With a suitable manipulation of the flow from the Sacandaga reservoir, this minimum flow of the Hudson at Spiers Falls can be raised to about 2,920 second-feet in a year as dry as 1908, and maintained continuously at not less than that figure, and the flood flow materially reduced. The stored water from the Sacandaga reservoir, if used alone in a steady flow on a fall equal to the aggregate of the successive falls from the mouth of the Sacandaga to tide water at Troy, would, in an average year, produce 40,000 twenty-four hour, seven-day horsepower throughout the year. As it will be used, however, the power from the stored water is of much greater value than the same amount of continuous power at a new site would be, because the water which would produce it would be applied to wheels and works already existing and now lying idle without it, thus requiring no investment for its application. Furthermore, the additional water power would not come in competition with other water powers, but would supplant steam auxiliary power, costing to produce, in the most modern plants, $40 to $45 per horsepower per year for twenty-four-hour continuous power. Twenty dollars per horsepower per year is, therefore, half the value of this additional water power as it may be used, and $10 is clearly a price sufficiently low to afford abundant encouragement to the development of the industries dependent upon these powers. The fact that this almost ridiculously low price would still leave a handsome revenue to the State indicates with absolute finality the commercial practicability of the Sacandaga project.

The value of the stored water was brought out in the second progress report by another method. The average flow of the Hudson is sufficient during the driest month of an ordinary dry year to produce 58,500 horsepower on the 450 feet of available fall between Hadley and tidewater. With the Sacandaga storage 144,000 horsepower could be kept constantly running throughout the year. The increase of power due to raising the low water flow would, therefore, be 85,500 horsepower. On this added power the low estimate of value of $5 per horsepower per year was placed. Five dollars will be recognized as an extremely low figure for water power added during the low water months. It has been used as representing an exceedingly conservative estimate of the possible financial return to the State and does not necessarily represent the basis on which benefits will be assessed. This dry weather increase in power has also the added attractiveness from the viewpoint of the power owners of requiring absolutely no new investment of capital and therefore no [illegible] adding in interest and depreciation charges and also no adding in running costs beyond the $5 mentioned. On the contrary, it will render effective throughout the year capital already invested.

Throughout a part of nearly every year and on rare occasions throughout an entire year, the natural flow of the river is sufficient to keep the present installations running at their full capacity. It is admitted that the millowners have an undisputed right to the full natural flow of the stream. The charge for additional water to be used during the dry periods therefore represents a charge for the assurance that the flow of the river shall never at any time fall below a given rate. In return for this payment the millowner is guaranteed a continued power without the use of the expensive steam auxiliary. On this basis an annual charge of $5 per horsepower per year seems very reasonable as a preliminary method of estimating the possible income to the State. The method ultimately to be used in determining the value of the benefits derived from the increased flow of the river is a matter for very careful study and future adjustment.

While the primary object for the State in constructing the Sacandaga reservoir should be to regulate the Hudson and obtain a revenue therefrom, yet it is desirable to bear in mind the possibility of a second stage of development, whereby 30,000 continuous twenty-four hour horsepower can be generated below the dam, utilizing the fall of the Sacandaga river between Conklingville and Hadley. The development of this power would require the regulation of the Sacandaga to a uniform flow of [illegible] second-feet at the dam site. Such a method of regulation of the discharge of the Sacandaga would still add about 1,400 second-feet to the low water flow of the Hudson, and 57,000 horsepower to the Hudson powers during low water months.

The market for the added power from stored water on the Hudson already exists, even to the extent that the wheels are installed, buildings erected and filled with machinery, and the operatives literally awaiting the hour for the water to be turned on to set the whole in motion.

The market for power which may be developed directly in connection with the Sacandaga dam lies in the municipalities of Albany, Troy, Mechanicville, Fort Edward, Sandy Hill, Glens Falls, Corinth, Utica, Schenectady and other communities which are within the zone of economical electric transmission.

The following table shows the relation of the probable revenues to the total estimated cost under the first stage of development when the reservoir is used solely for the improvement of power on the Hudson. The figures are those used at page 579 of the last annual report.

Cost.

Total cost of Sacandaga dam and reservoir without power development	$4,650,000

Yearly Charges.

Yearly interest at 3 per cent	$139,500
Annual sinking fund payment on a 3 per cent., fifty-year basis	41,200
Compensation to towns on account of taxable property converted	10,000
Maintenance of State highways (original cost included in total cost)	15,000
Depreciation and repair	15,000
Operation and administration	17,000
Total yearly fixed charges and maintenance	$237,700

Revenue.

Annual gross earnings from 85,500 added horsepower at $5 per horsepower	$427,500
Deduct yearly charges as above estimated	237,700
Estimated annual net revenue to the State	$189,800

The original estimate of cost and revenue was prepared by Mr. Freeman in his report of 1908, and, with slight modifications, was used as above by Mr. Ropes in the second progress report. Its figures as to probable cost are admittedly very liberal. Estimates based upon the studies of the past year lead to the conclusion that the Sacandaga reservoir can be built at a considerably lower cost, say $4,000,000, on account of possible changes in the location and section of the dam and spillway and the probability of acquiring the land at a much lower figure than that used by Mr. Freeman. Nevertheless, in view of the fact that the exact location for the dam has not been determined or the character of the foundation completely explored, it is deemed wiser to adhere in this report to these figures than to use the reduced estimate at the present time.

In estimating the probable net revenue, the annual cost would be increased and the surplus thereby reduced if the sinking fund be considered upon a thirty-five year instead of a fifty-year basis. The net annual revenue in this case would still amount to $154,100.

From this conservative estimate it is clear that the sale of the water stored by the Sacandaga reservoir will:

(1) Pay all operating and interest charges.

(2) Refund in thirty-five or fifty years all the original cost.

(3) Add to the general revenues of the State, annually during the bond period, a sum equal to 3½ per cent. or 4 per cent. on the original investment and

(4) Leave the State at the end of the bond period in possession of the reservoir and all the appurtenant works, and in the enjoyment of a perpetual revenue subject only to a relatively small offsetting charge for maintenance, operation and taxes.

SCHROON PROJECT.

The regulation of the Hudson by means of storage reservoirs in the Schroon river basin has been studied, and the results were set forth in the last report from the viewpoints of (1) a single great reservoir including the present Schroon, Brant and Paradox lakes, controlled by a dam at Tumblehead Falls raising the water to elevation 840 (thirty-three feet rise over Schroon lake);

or, (2) a reservoir at the same place with flow line at elevation 825 (eighteen feet rise on Schroon lake) controlled by a dam at Starbuckville, thus involving less damage to existing settlements and property, but requiring for complete control of the watershed that the main reservoir be supplemented by a number of smaller reservoirs higher up. In either project the total storage would be 16,000,000,000 cubic feet. The construction of the single large reservoir was favored.

The annual rainfall on the watershed is thirty-eight inches, considerably lower than that on the Sacandaga and somewhat lower than that on the Upper Hudson area.

The discharge of the Schroon at Tumblehead varies from a monthly maximum of 4,000 second-feet to a minimum of 100 second-feet and averages 900 second-feet. The effect on the Hudson river of the 16,000,000,000 cubic feet of storage would be to assure a flow of 1,800 cubic feet per second at Spiers Falls throughout an ordinary dry year instead of the present average minimum of 900 second-feet or the lowest recorded monthly rate of 684 second-feet which occurred in September, 1908.

The stored water from the Schroon reservoir, if used alone in a steady flow on a fall equal to the aggregate of the successive falls from the top of the present Hadley dam to tidewater at Troy, would in an average year produce about 10,000 24-hour, 7-day horse-power throughout the year.

The plans for the Schroon reservoir do not contemplate any immediate power development at the dam site, though there is a fall of seventy feet which may be practically developed. For the best regulation of the Hudson, however, water would have to be completely shut off at times from the Schroon river at the reservoir dam and damages allowed to present power site owners on the Schroon river below, or else, as was suggested by Mr. Freeman in the second progress report, 300 second-feet of water must be allowed to flow out of the Schroon reservoir for the use of the powers on Schroon river during the time when the reservoir would be shut off if Hudson river power only were considered. On this basis the minimum regulated flow of the Hudson at Spiers Falls would be somewhat less than that stated above, but about 52,000 H. P. would be added to the low-water capacity of the Hudson plants.

This power, as has been explained in the case of the Sacandaga reservoir, would, however, replace auxiliary steam power and would be of much greater value than the same amount generated at a single new development.

The following table based on the latest studies indicates the relation between estimated cost and revenues for the Schroon project:

Cost.	
Estimated cost of reservoir and dam including all real estate, new highways and interest during construction	$1,900,000
Yearly Charges.	
Interest at 3 per cent	$57,000
Annual sinking fund payment to retire bonds in fifty years on a 3 per cent basis	17,000
Compensation to towns for taxable property converted	5,000
Maintenance of State highways built in place of present town roads	7,000
Depreciation and repair	5,000
Maintenance and operation	17,000
Total yearly fixed charges and maintenance	$108,000
Revenue.	
Annual gross earnings from 52,000 horsepower at $5 per horsepower	$260,000
Deduct annual fixed charges as above estimated	108,000
Estimated annual net revenue	$152,000

On this basis, as in the case of the Sacandaga project, the cost of the reservoir would be retired in fifty years, leaving the State in sole possession of the works and the revenues therefrom, and during the same time a substantial sum would be added to the yearly revenues of the State. The conditions of the market and direct and indirect benefits for this power are precisely the same as for the Sacandaga reservoir and it is merely a question, as far as the immediate regulation of the Hudson is concerned, of the relative merits of these two great projects as affecting the same market.

ADVANTAGES OF THE SACANDAGA PROJECT.

In the last report the Sacandaga and Schroon projects were compared, to determine their relative availability for early construction in the effort to regulate the Hudson. Mr. Freeman in his review of the season's work, showed that either of these reservoirs presents great advantages over any other site on the Hudson, or possibly in the State, for the first development, and was inclined to favor the Schroon project for first construction, on the grounds of its apparent lower unit cost, better natural dam site, and the high proportionate effect of the storage on the flow of the Hudson relative to the total cost, as compared with the Sacanadaga.

During the past year several important developments have contributed to turn the balance between the Schroon and Sacandaga reservoirs in favor of the latter. The first of these concerns the thirty or more acres of State land which the Commission has up to the present time reported as constituting the principal obstacle to immediate construction on the Sacandaga. At the time of the last report, the State claimed to own and was in actual occupation of a small piece of land which would be flooded by building this reservoir. Within the past few months the Commissioners of the Land Office, who have the duty of passing upon the title and character of the land holdings of the State, have made an investigation into the status of this parcel. The Forest, Fish and Game Commissioner, to whom the matter was referred by the Land Board reported that this particular piece of State land, according to the best evidence obtainable, was not wild forest land when acquired, and, therefore, does not fall within the constitutional prohibition against the disposal of State forest lands or the destruction of the timber thereon. Under the provisions of the Constitution and the Public Lands Law, the State, therefore, has the right to sell this piece of land, and it is understood that the preliminary steps to this end have been taken. This constitutional barrier, as far as it operates to prevent the construction of the Sacandaga reservoir, has, therefore, been removed.

In the second place, continued study of the rainfall and stream flow records, on the basis of the latest information obtainable, tends to establish with greater certainty than before the fact that the Sacandaga watershed is one of the most prolific water-bearing regions in this section of the State, while at the same time the later results on the Schroon are not as favorable as the first. This point is brought out in the report of the engineer, page 188 below.

Furthermore, the estimates for the two projects were made by different engineers and that for the Schroon reservoir upon a less liberal basis than that for the Sacandaga. Also the method of estimating the probable revenue from the amount of power added in the driest month of the year, while a good method of showing the great value of any one project, results, under conditions which exist on the Hudson river, in distorting in favor of the Schroon the relative values of the actual average power added by each project.

GENESEE RIVER.

The Genesee river, flowing through a fertile valley, which contains the third largest city in the State, presents for consideration a particularly good example of the possibility and need of combined power development and flood prevention. What is perhaps the second greatest practicable storage basin in the State exists at Portageville, fifty miles south of Rochester, where a single dam located at the southern limit of the rock gorge containing the Portage Falls will store 18,000,000,000 cubic feet of water, over about fifteen miles of the river valley. This stored water may be utilized under alternative or combined plans (1) for the development of a large amount of power below the dam, (2) for the regulation of the river to increase the capacity of existing plants at Rochester, and (3) to mitigate the floods which now spread annual destruction through the valley between Mount Morris and Rochester. All this can be accomplished without injuring the scenery of Letchworth Park, and provision has been made in all plans for a flow over the Portage Falls adequate to maintain their natural beauty.

The mean annual rainfall of the Genesee watershed above the dam as disclosed by the studies of the Commission is 36.2 inches.

The flow of the river at Portage varies from a maximum of 25,000 second-feet to a minimum of 80 second-feet and averages about 1,000 second-feet.

The possible power development at the dam at Portageville, if such development be considered as the main object, would total 30,000 continuous 24-hour, 7-day horsepower, and the same water would still add 12,000 continuous horsepower to plants now operating down the river. If built for the sole object of regulating the river for the benefit of existing plants, the Portage reservoir would add 20,000 horsepower to the present development during the dry months of the ordinary year.

If it appears feasible under present or future laws to combine with the power development, the prevention of floods in the Genesee valley, for which proceedings have been brought under the River Improvement Act, this object can be fully attained by special provision in the plans for the dam whereby the upper 19 feet of the reservoir may be reserved for the special purpose of catching and retaining the crest of the Genesee flood. Such special provision is necessary because the use of a reservoir for power development is not entirely compatible with its use for flood prevention. As a general principle regulation for flood control demands a reservoir kept drawn down to catch expected floods just at the time when for the purposes of power development it should be filling up. With provision that the upper 19 feet of the Portage reservoir be reserved for flood regulation, the rest of the storage to be used for power purposes, both these objects could be accomplished. The initial outlay for dam and reservoir complete would be $4,518,000 with the dam located at the site, which, from an engineering point of view, is ideal. If it were deemed essential to avoid the use of a narrow strip of land about 100 feet wide extending 2,000 feet south along the river shore, and included in the property deeded to the State by Mr. William P. Letchworth, the cost of the Portage project would be nearly $1,800,000 more, or $6,294,000. These figures are on the basis of a reservoir without power development. With a full equipment to develop 30,000 continuous horsepower below the dam the cost would be approximately $6,750,000, or $8,500,000, depending on the dam site selected.

With the dam constructed at the less expensive site as recommended in the last report of the Commission, the estimated annual carrying charge on the total outlay of $4,518,000, with bonds at 3 per cent., would be $200,000. This annual carrying charge could be met by a payment of $10 per horsepower per year for the 20,000 horsepower added to the plants on the lower river, without taking into consideration the returns which may be derived from an assessment on the lands that would be protected from flood damages.

If, on the other hand, it is decided to construct the dam and reservoir with the pressure tunnel and power house, but without hydraulic or electric machinery, the estimated annual carrying charge on the total outlay of $6,800,000 would be $300,000, which includes, besides maintenance charges, an annual sinking fund payment of $60,300 and an interest charge at 3 per cent. amounting to $204,000. Under this plan the State would lease the water under pressure ready for transformation into power at the end of the three-mile tunnel leading from the reservoir. Considering that the State under this plan would own all but the turbines and generating machinery, an annual charge of $10 per horsepower for the 30,000 horsepower, which could be developed, seems entirely reasonable. This would bring $300,000 per year. In addition the flow of the stream would still be regulated sufficiently to add 12,000 horsepower to the existing plants at Rochester, which on the basis of the estimate used elsewhere, would be worth, at the lowest figure, $5 per horsepower per year, resulting in an income from this source of $60,000. Under this plan of development the State would, therefore, receive a gross annual revenue of $360,000 and after deducting the annual carrying charge of $300,000, a net annual revenue of $60,000 would still remain.

The construction of the Portage reservoir as a business proposition is shown by these facts to rest on two factors still to be fully determined; namely, the extent to which a market can be found for the great amount of power which might be developed or added to existing plants, and the extent to which the beneficiaries of flood prevention and the dilution of Rochester sewage can be assessed their due proportion of the cost. The total cost of the project as shown by the preliminary estimates is large, involving a gross outlay considerably in excess of that required for the Sacandaga reservoir. There does not appear to be so extensive a market ready and waiting to take up and use the stored water immediately, as is the case on the Hudson. As a power development alone, therefore, the Portage reservoir is not the most inviting for the investment of the State's money. From the figures above quoted it will be seen that under the first alternative plan, the return from power would barely suffice to pay the annual carrying charge. The objects to be attained by this project, other than that of power, therefore, constitute an extremely important factor. If the proposed power project can be successfully combined with the project for the control of the Genesee floods, and a proper sharing of the cost provided for on this basis, there is no reason why the construction of this reservoir should not be among the first attempted by the State.

RAQUETTE RIVER.

The importance of providing artificial storage on the Raquette river is measured by the need of regulation for existing developments, and the benefits which would accrue both to these existing developments and to large new developments which would be rendered commercially feasible as a result of the construction of storage reservoirs. The great losses which have been sustained in the past two years in connection with the operation of the existing developments, on account of shortage of water, would be largely reduced and there would be a considerable saving of coal which would otherwise be burned in order to produce auxiliary power during the dry months of the year. Incidentally, considerable advantage would accrue from the construction of reservoirs by way of reduction of floods, extension of transportation facilities over proposed reservoirs, and the submergence of swamps which menace public health.

On the principal power district of this stream, namely from Piercefield to Raymondville, there are at present developments utilizing in the aggregate about 275 feet fall and with wheels installed to a capacity of about 33,000 horse power, of which about 5,000 horsepower is continuously idle owing to lack of water. It has probably not been possible to operate as much as 10,000 horsepower continuously during the low water periods of the last two years. The continuous dependable power output of these existing developments could probably be increased to about 50,000 horsepower by a complete system of water storage reservoirs permitting the installation of additional water-wheels with a capacity of about 17,000 horsepower.

In addition to the present developments there are undeveloped falls aggregating about 820 feet which with regulation could be developed to the extent of about 130,000 horsepower. There is, therefore, a possibility of approximately 180,000 continuous dependable horsepower resulting from a complete system of storage reservoirs, as compared with a present liberally estimated dependable output of 10,000 horsepower at the existing plants.

A comprehensive study of the watershed for storage possibilities as detailed in the Second Progress Report disclosed eleven (11) possible storage reservoir sites of which seven (7) were found at that time, or by means of further investigation or more complete study have since been found to be impracticable, either on account of small drainage area, small storage capacity, unfavorable natural conditions, or excessive cost.

Of the remaining four, several alternative combinations are possible to produce the required amount of storage for practically complete regulation of the river in the principal power district below Piercefield.

The details of the studies on the Raquette are contained in the reports of the engineers, accompanying this volume, and in the second progress report. It is considered sufficient at this juncture to point out the salient features of the alternative plans mentioned.

One of these alternatives contemplates the construction of a very large reservoir by means of a dam across the river in the vicinity of Tupper Lake village or near Piercefield, where it is considered practicable to construct a dam of such height as to provide all the storage that may be required, estimated at about 21.6 billion cubic feet. If not found feasible in the final analysis to construct a dam at this point of a height sufficient to give the required capacity, there is a further possibility of erecting a secondary dam of greater height in the vicinity of the Oxbow, thus creating practically one large reservoir of two different water levels. This project involves flooding about 5,000 acres of State lands and hence must wait for the proposed constitutional amendment before it can be built.

Another plan contemplates the ultimate construction of a reservoir of less capacity at Big Tupper lake, with a dam at Site No. 1 near Tupper Lake village, or at the Oxbow, and the early construction of from one to three smaller reservoirs at the Little Tupper-Round lake, Forked lake and Long lake sites. The first step in this plan would be the construction of a storage reservoir by a dam at the outlet of Little Tupper and Round lakes, which could be used either to relieve the low water shortage at the existing power developments on the main river by varying amounts each year, or to guarantee a certain minimum flow throughout every year, based on the flow of a dry year.

An alternative plan which appears worthy of further study consists of a combination of the Little Tupper-Round lake with the Forked lake project by means of a connecting tunnel whereby a catchment area of 247 square miles would be controlled. It is feasible to construct a dam for the Little Tupper-Round lake project which would create a reservoir of greater capacity than its catchment area of sixty-six square miles would warrant. In the Forked lake project, however, the water supply from the 181 square miles of contributing area exceeds the maximum capacity of the reservoir which could be constructed at that point. By means of the tunnel and aqueduct the surplus water in the Forked lake district can be carried over and conserved in the Little Tupper reservoir, and ultimately returned to the natural course of the river through the Slim ponds, or to Big Tupper lake by a shorter route through Bog river.

It has been found impracticable with the time and funds available to determine absolutely the order in which these various alternative projects on the Raquette river should be constructed. The ultimate choice of projects for immediate construction and the order in which the others shall thereafter be constructed, will rest primarily with the people of the community interested, as contemplated by the proposed bill and plan of the Commission.

It has also been found impracticable to make strictly accurate estimates on all of these alternative plans owing to the lack of time and the uncertainty which exists as to the proper value of the required lands which are now used as private preserves. The cost of these lands and the clearing of the same are important factors in determining the financial feasibility of all of these projects.

Owing to the fact that the existing power development on the river utilize only about 275 feet of the 1,095 feet total fall which is capable of development on the river below Piercefield, it is apparent that any considerable development of storage would involve comparatively high annual charges against existing power developments to meet the annual carrying charge, or would necessitate a portion of the charge being borne by the undeveloped fall in order to insure a net revenue to the State in excess of the carrying charges.

The details of the estimates of cost and probable revenues resulting from the construction of several alternative plans are contained in the report of the Consulting Engineer at page 150.

RECONNAISSANCE STUDIES.

The three rivers above discussed, namely, the Hudson, Genesee and Raquette, include the four projects which the Commission has been able to study with the fullest detail. Because the limited time and appropriations and a due respect to the proportions of the study of the entire State compelled a restriction of the very expensive topographical surveys to a few promising and typical sites, the impression should not arise that consideration, or even first attention under the State's plan of development is necessarily to be limited to these rivers. While the Commission has been obliged to confine the complete determination of reservoir topography to certain selected projects, it has at the same time made a careful study, by means of extended reconnaissances, of the principal opportunities for a development on all the noteworthy power streams of the State. In this manner the necessary data has been secured and recorded to give intelligent direction to fuller and more detailed studies whenever the State decides to enter on a plan of development, and also to provide a basis for quickly and justly determining the relative importance of investigations for which petitions may be filed under the plan which the Commission now proposes, in case such plan shall be adopted.

The succeeding paragraphs describe the streams which have been examined in this manner, and indicate by reference in each case where, in all three reports of the Commission, a fuller discussion of the facts may be found.

OSWEGO RIVER.

The Oswego river, and its principal branches, the Oneida and the Seneca, constitutes one of the largest drainage basins of the State, with an area of about 5,000 square miles. This great watershed, including the nine large " Finger lakes " and great expanse of low flat land, provides enormous facilities for artificial water storage. The statistics obtained show an existing total development of 57,000 horsepower on this watershed, giving it a rank in this respect among the three or four most important drainage areas of the State. The Commission has already discussed the importance of the Oswego system at page 218 of its Fourth Annual Report, and some of the results of a considerable reconnaissance made in the summer of 1908 are published in the engineer's report at page 592 of the same volume.

This stream particularly illustrates the need of a comprehensive State policy which shall take full account of all the uses of the water resources of the State, whether for the canals or for power. Such a policy would combine these two objects in an economical and integral scheme of development calculated to bring the fullest possible results in both directions.

During the past season little or no additional work has been possible on the Oswego, and the Commission is compelled to content itself with again emphasizing its great importance as a power stream, and expressing the hope that an appropriation may be made to permit a complete study in the near future.

BLACK RIVER.

The studies made from existing reports and maps and by examination during the season of 1908, together with a very extended and careful reconnaissance of the Black river drainage basin during the past summer, indicate that this stream is another of the chief rivers of New York in respect to existing power developments and the need and possibility of regulation. The industrial development and prosperity of this large section of the State depends almost entirely on the developed water falls of this river. The city of Watertown was one of the half dozen settlements which were located by the pioneers of New York entirely on account of the natural water power advantages. The present possibilities of the main stream have been very completely developed and the water-power industry has been compelled to seek new sites on the principal tributaries, the Moose, Beaver, Deer, Independence and Sugar rivers.

Plants already installed on the Black river watershed have an aggregate capacity of about 89,000 horsepower. Owing to the commercial needs of the community this development has been carried far beyond the low water capacity of the streams, with the result that during many months of the year the plants are unable to run at more than one-third or one-fourth of their full capacity, except by the use of expensive steam auxiliary. This of course entails a great deal of loss, not only to the power owners, but to the community at large.

The possibilities of regulation, as disclosed by the studies made are not as great as on some other streams, but the profiles of the tributaries offer opportunities for considerable future development. This fact, together with the large wheel capacity of the present installations, renders whatever storage may be obtained, of exceptional value. The larger portion of the drainage area of 1,930 square miles lies in the Adirondacks in the very heart of the area of the highest rainfall in the State. Owing to this prolific rainfall and to a certain amount of artificial storage at Beaver Flow and on the Fulton Chain lakes, the stream is a good water producer with a fair degree of uniformity of flow. Five storage reservoirs with a total capacity of 13.4 billion cubic feet have been noted and studied as fully as practicable with the time and means at hand. It appears that should all of these reservoirs be built, power plants from Carthage to Lake Ontario, in which district the bulk of the present development of power in the watershed occurs, would be able to run practically the entire year without any diminution in output because of lack of water. In addition, some 25,000 undeveloped horsepower would become available along the tributaries as a result of the building of these reservoirs.

Extending from Carthage to Lyons Falls, there is a possible reservoir basin, with an area of seventy-four square miles, where 58 billion cubic feet of water could be stored. This site was studied in considerable detail by the Deep Waterways Board in 1900 and by our engineers both last season and this. The five small reservoirs already noted will afford, at less aggregate cost, such a large measure of relief to the power industries below Carthage that the need for the Carthage reservoir will be greatly reduced for the present at least. Furthermore, its construction would effect so extensively the railroad lines of this section and would flood such a large cultivated territory, and the cost would be so great in proportion to the benefits to be obtained as to render the proposition an unattractive one at the present time. On account of the topographic feature of an extensive and almost flat basin a reduction of the size of the reservoir would not tend to render the project more attractive, since the extent of land flowed and other property damages, which represent the larger portion of the estimated cost, would not be decreased in proportion to the reduction of the volume of storage.

The situation at the Carthage site again emphasizes the importance of the State exercising such control of possible reservoir sites as will enable it to protect them from being rendered impracticable by the location of some important enterprise or undertaking such as the projection of a new railroad within the limits of the flow line. In many cases, at the inception of such a project, the construction could be located outside of such flow line with little or no increase in cost; whereas once located within the flow line a change of existing structures might be so expensive as to prevent the utilization of the basin for storage purposes. While the Carthage storage project, for instance, does not seem at the present time to be attractive, yet it is conceivable that at some future time the demand for increased power may be so great as to warrant its construction. At any rate the State, in its foresight, should exercise the control referred to in this case if found wise, or in other cases where the wisdom of so exercising it might be even more evident.

The Black river in point of developed power is second only to the Hudson, and because of the importance of this power and of the resulting manufacturing undertakings this stream will stand very high among the rivers demanding early consideration by the State. For these reasons, we recommend that surveys and designs for storage and power on the tributaries as noted in the report of our engineers be made during the coming year, together with a more extended study of the effect of these reservoirs upon the regulated flow of the stream and the output of the existing power plants, so that the possibilities in this watershed may be as clearly and fully set forth as has been done for those on the Hudson, Raquette and Genesee rivers.

The Black river and the other streams in the northwestern part of the State, including the Oswegatchie, Grass, St. Regis, and the two Salmon rivers, are more fully treated in the engineer's report at page 201 below.

OSWEGATCHIE RIVER.

Although the Oswegatchie with its 1,609 square miles of drainage has almost as large a watershed as the Black, it is by no means so important as a power producer. This is because it has no great fall below the point where the tributaries join to form the main river, and because its principal tributary, the Indian river, leaves the foot hills of the Adirondacks comparatively near its source and before any considerable drainage area is available to produce a large flow. However, such opportunities as exist for the development of power in the lower reaches of the Oswegatchie and Indian rivers have been quite generally taken advantage of, with the result that waterpower plants with a total capacity of some 22,000 horsepower have been constructed along these rivers. A reconnaissance of this watershed somewhat in detail was made during the past season to show the storage possibilities and the resulting increase in available waterpower. Storage opportunities at Cranberry lake, Newton Falls, Harrisville and Black lake were examined. It appears that the available storage at the first three points would increase the minimum power at existing plants by about 10,000 horsepower and at undeveloped sites by about 8,000 horsepower. Cranberry lake and the swampy region above Newton Falls, which sites are the most promising as regards storage and resulting power, would be improved as far as scenic effect is concerned by their utilization for storage, and at the same time represent the greatest return from this storage in increased waterpower available. It is, therefore, recommended that provision be made for surveys at an early date to determine more exactly the amount of storage obtainable and the extent and location of developed and undeveloped power possibilities which would be effected by any proposed storage at these two localities, Cranberry lake and Newton Falls.

The storage possibilities at Black lake, while very large, would regulate the flow of the river through such a slight fall that it is doubtful whether the resulting increase in power alone would justify a project of such magnitude and expense. However, should the power owners and other interests benefited be able to assure a suitable yearly return on the investment to the State, the project would probably be entirely feasible.

SALMON RIVER — (OSWEGO COUNTY).

The Salmon river, with a drainage area of 264 square miles, lying between the Black and Oswego rivers, flows into Lake Ontario just below Pulaski. A large storage basin near Redfield with an available power site, under high head, at its lower end, presents the most attractive opportunity on this stream for the development of power from a regulated stream flow. In addition to the reconnaissance made by our engineer during the past season, this reservoir project has been studied in considerable detail by the Deep Waterways Board, and a reservoir capacity of 5.2 billion cubic feet has been indicated. No State land would be flooded by the proposed reservoir, the cost of which would probably not be in excess of $1,350,000. There are opportunities on this stream of developing from a regulated flow about 25,000 continuous horsepower. With a rental of $10 per annum per horsepower, a yearly revenue of $250,000 would result. The interest, sinking fund and maintenance should not exceed $75,000 per annum, leaving a net yearly revenue to the State of approximately $175,000 on the investment of $1,350,000. The Oswego Light and Power Company has been organized to take advantage of this opportunity and proposes to develop about 300 feet of the fall. This is a peculiarly good illustration of the advantage of

State development and the need of early decision as to the future policy. A complete utilization of the opportunity at this point would develop the head of 405 feet instead of the 300 feet proposed by the company. Because of the need of this power for the development of that portion of the State, and because there seems to be a well defined probability of a ready market for the power when developed, it is recommended that complete surveys and designs for both storage reservoir and power development be made with a view to the weighing of this project in the same careful and exact manner as that pursued with regard to the principal opportunities on the Hudson, Raquette and Genesee rivers, so that this apparently attractive possibility may be placed in its proper sequence in.the plan for conserving the water powers of the State.

GRASS RIVER.

This river has a long, narrow, and deeply eroded watershed, and flows from a high plateau near its source to the more level country in the vicinity of its confluence with the St. Lawrence river; where its drainage area is 637 square miles. The stream very closely resembles the Raquette river in its watershed characteristics. The reconnaissance made this year revealed three promising storage basins, with an aggregate capacity of probably five billion cubic feet and an increase in the available waterpower of the stream, provided the storage reservoirs are built, of 15,000 horsepower as against 3,000 horsepower developed at the present time. The Grass river valley above Russell is very wild and far removed from a possible market for waterpower. As this is the region in which most of the power increase would be situated it is not recommended that anything further be done in the study of this watershed at the present time.

ST. REGIS RIVER.

The St. Regis river with its 664 square miles of drainage, like the Oswegatchie, splits up into several important branches not far from its mouth. However, the power possibilities are very much greater in proportion to its drainage area than those of the Oswegatchie, because the east and west branches flow for a considerable distance through a plateau at an elevation of about 1,500 feet above the sea before dropping to the lower region of the St. Lawrence river. With the exception of the east branch these tributaries flow through a wild and rugged country, remote from any railroad line, sparsely settled, and with little demand for water-power at the present time. Four promising reservoir sites were noted, with a combined capacity of five and one-half billion cubic feet, giving an increase of about 25,000 horsepower in available power due to storage, as against about 4,000 horsepower at present developed. From St. Regis Falls to Buckton, on the east branch, there are some very fine opportunities for the development of power which is fairly accessible to territory covered by railroad development, and where there is consequently a possibility of a comparatively early market for power. For these reasons it is recommended that some further study be made of the storage and power opportunities of the east branch. On the rest of the watershed no further study seems necessary at the present time.

SALMON RIVER — (FRANKLIN COUNTY.)

This river lying east of the St. Regis, with a drainage area of 480 square miles at its mouth, rises in the high plateau of the Adirondacks. A careful reconnaissance shows that there is one promising reservoir site at Titusville with an attractive power possibility immediately below it, as well as plants of the capacity of 4,500 horsepower at various points along the stream which would be benefited by the construction of such a storage reservoir. The available power on the stream would be increased by 9,000 horsepower should the reservoir be built. There is very good prospect for a demand for some at least of this increased waterpower, but as the reconnaissance covers this watershed with sufficient completeness for present purposes there is no need of further study until a sufficiently large demand for power shall arise.

SARANAC RIVER.

The salient feature of the ultimate development of the Saranac watershed must be the two reservoirs proposed in the report of our engineer in connection with the Saranac lakes. These reservoirs would make these very attractive lakes much more attractive by covering great areas of swamp lands and flowed lands covered with dead timber, bringing the water up to the steep shores lying back of them and thus making the full shore line available for summer homes. The water surfaces are so great that the use of stored water need not lower the lakes more than six feet until after the summer visitors have left, and still a large volume of stored water would be released. With this stored water an aggregate of 75,000 horsepower on the Saranac river will be practicable of development in place of the 24,000 horsepower now developed. Whether the stored waters be used in aid of power development or not, the construction of these dams would be desirable from a scenic and sanitary standpoint.

Other reservoir sites on this basin were visited; but it was concluded that these sites are now serving their best purposes as summer playgrounds for the people, for which they are so particularly fitted, that consideration of their use as reservoirs was, for the present, dropped.

The market demands for power on this stream are such as to warrant immediate preliminary action, and in addition to this fact there is at present local agitation for action with a view to the betterment of sanitary and scenic conditions.

The Saranac, Ausable, Chateaugay and remaining Adirondack streams are discussed in the report of the engineer, page 147 below.

AUSABLE RIVER.

On the west branch there is an excellent reservoir site in a basin devoid of natural lakes. Below this the State has, through ownership of lands, a large interest in a magnificent waterpower having a total fall of 550 feet. On this fall and those below over 30,000 horsepower is practicable of development.

On the east branch there is a good reservoir site embracing the upper and lower Ausable lakes, which is deserving of investigation with a view to ultimate development. Remoteness from large centers of population and the fact that only 4,000 horsepower will be developed at the site make this reservoir less attractive for immediate development.

While we do not believe that the market demands in this vicinity call for the immediate development of this stream, we think that surveys should be made in order to bring out fully what the possibilities are, exactly what is the relation of the State to the project, and in order to stimulate power production on the stream.

CHATEAUGAY RIVER.

Natural conditions are very good for a storage reservoir covering upper and lower Chateaugay lakes. As only about 18,000 horsepower can be developed within the State, utilizing the full fall of the river, this stream is of minor importance as compared with the many large projects demanding the immediate attention of the State. The ease with which storage can be obtained, however, and the activity being displayed on the stream by power users may make it desirable to prosecute the final surveys. This is a matter which can well be left to the initiative of the power owners for action under the proposed new legislation.

CATTARAUGUS CREEK.

This relatively small stream, which drains 560 square miles and is tributary to Lake Erie, is one of the most prolific in the State, outside of the Adirondacks, and enjoys the further advantage, from a storage standpoint, of partial forestation and sparse settlement in its watershed. Only a small amount of storage capacity has been discovered, but this will be of value because of the comparatively uniform discharge of the stream. The construction of a small reservoir at Zoar will make practicable the development of a fall which is not now utilized, at Versailles, and also add materially to the summer flow, which is insufficient for the small plants already located on the stream.

OTHER RIVERS..

The results of an extended study of the Delaware river were published in full detail in the second progress report. The engineer's reports which follow contain accounts of opportunities and conditions on a number of other streams examined during the past season, including especially the Chazy, Boquet, Susquehanna, Chenango, Canisteo, Cohocton, Upper Genesee and Allegany rivers, and the Buffalo, Cayuga, Cazenovia, Eighteen-Mile and Oak Orchard creeks.

IV. STATE CONSERVATION OF WATER POWER.

The facts stated in this and in the earlier reports of the Commission have sufficiently indicated the importance and variety of the waterpower resources of New York. The State is not only situated in the section of the Atlantic coast most favorable to the existence of waterpowers, but has been further and specifically provided with climatic, geological and topographical conditions which result in numerous and well-distributed opportunities to harness the energy of falling water. It has been shown that the value of this resource is potentially very great, but that at the present time it is in large part lost through the irregular and uncontrolled flow of practically all streams. The opportunity for the State to correct this defect, to its own great profit, has long existed and the necessity of taking this step is more widely realized every day in proportion as the industrial growth of the State and the increasing dependence on waterpower emphasize the disastrous effect on the public welfare, of the erratic and unconserved flow of our rivers. The time has come when the State, in the exercise of its function of furthering the public welfare, should undertake the control of its rivers so that the direct benefits of increased water power and the indirect advantages in the prevention of floods, the improvement of navigation and the protection of sources of water supply may be equally distributed among all the citizens of the State, and a just compensation assured to the public in return for the use of public wealth.

MEANS OF REGULATING STREAM FLOW.

No extended argument is needed to establish the scientific necessity of building artificial storage reservoirs for the conservation of water resources and the regulation of the flow of our rivers. The extreme fluctuations between the high and low water flow of all our streams, already frequently discussed in this report, constitute a condition generally known and widely deplored. No elaborate research to establish the cause of such variation of stream flow has been attempted by the Commission, as it is deemed sufficient to refer to the generally accepted causes to be found in the seasonal variations of rainfall, the progressive deforestation of watersheds, and the clearing and cultivation of the land. It is in truth an actual and serious condition which confronts us and not an academic theory.

The Federal conservation experts are authority for the statement, which is supported by common observation, that the level of the underground water table has been for many years sinking deeper into the earth. It is said that in earlier years the first 100 feet of the earth's crust contained in saturation, water equivalent in quantity to a solid volume twenty-five feet in depth over the same area. This immense underground reservoir is the source to our wells and springs and also the source, which, in the past, by seepage in the river beds, contributed to keep up the flow of streams during the dry months. Following the general deforestation, clearing and cultivation of the land, the level of this water has now gone down to such an extent that wells and springs, which even within the memory of living men maintained a perpetual flow, have now run dry. Similarly the seepage from the underground water into the stream beds no longer suffices to maintain their flow during the dry months. It will doubtless be a prominent part of the conservation movement in the future to investigate and determine what means are possible to effect the raising of this underground water table. The attainment of this object, however, is a matter for the distant future and it is certain that complete success in this respect would mean far from a complete control of stream flow. The effect of seasonal variations of rainfall would still remain and our annual spring freshets would not be prevented. The waterpower industries suffering from shortage of water in the dry months find little comfort in such speculations as to the future.

The Commission accepts to some extent the widespread belief in the regulating effect of forests on stream flow. In spite of ably advanced opinions to the contrary, the consensus of opinion of the majority of engineers and experts is that upon the whole, forests exert an important influence in storing the water from the clouds and thereby helping to maintain the regulated flow of streams. But the forests have been necessarily and permanently removed from many of the watersheds of this State outside the forest preserves, and it is impossible to undertake the wholesale reforesting of entire watersheds that would be needed to bring about through river regulation, even assuming it to be beyond question that such an effect would result. But even complete forestation would not effect such a retention of spring flood waters as is necessary to regulate our power streams to their highest average efficiency.

Turning, therefore, from theoretical to practical considerations, and considering the fact that the forests cannot in any case be completely restored, or the level of the ground water be raised for a generation, if ever, it is clear that if regulation is to be accomplished, water storage in artificial reservoirs is the immediate practical step which must be taken.

Fortunate, therefore, is any State which like New York has been naturally endowed not only with many lakes, rivers and favorable water power conditions, but also with streams of such profile, and natural basins of such capacity, that the engineering skill of man is given a favorable opportunity to improve natural conditions of stream flow by the construction of storage dams and reservoirs. In many sections of the country rivers are numerous whereon storage basins are entirely absent or of insufficient capacity for the purpose of regulation. Such streams, especially if their watersheds have been deforested, seem doomed to a perennial history of flood destruction in the spring and irremediable drought in the summer and fall with the attendant loss of power efficiency. This point is emphasized in order that there may be a due appreciation of the many favorable storage opportunities which have been scattered here and there through this State by the forces which made the hills and valleys. A glance at the map of New York with its many blue spots of water surface will indicate to the most inexperienced layman where natural depressions have been permanently filled with water by nature, to form the innumerable ponds and lakes of our State. It will not disclose, however, the many basins of similar character which could be filled by means of a relatively easy exercise of human effort in the construction of barriers for the collection of waters now running off in waste and destruction. While only the practiced eye of the engineer can read these basins from the map, it requires but a casual inspection on the ground by the unprejudiced observer to indicate clearly the natural opportunities for water storage, as well as the many instances in which existing swamps and unsightly conditions would be removed from the landscape by the construction of reservoirs.

SCOPE OF THE INQUIRY.

In urging a comprehensive plan of State conservation of water resources, the Commission is aware that a strict construction of the Fuller act, and its direction for a plan of waterpower development, might not seem to disclose a justification for every aspect of such a program. But the Commission has been forced by growing conditions to a liberal interpretation of this law, taking into account the antecedents of the bill and the evident purpose of the Legislature. Considering this act in connection with the general statutory powers of the Commission and reading it in the light of the Governor's recommendations, of his subsequent public utterances, of the supplemental appropriations made by the Legislature to carry on the work, and of the general and growing interest in the conservation of natural resources, the Commission is forced to conclude that its paramount duty is to urge upon the State a comprehensive and integral program for the protection and utilization of the waters of the State in the public interest. While the Commission is directed by the Fuller act to point out the number and value of the rivers and streams for waterpower, it is clear, in view of all the circumstances, that no program of development should be urged or adopted which fails to give due consideration to all other aspects of the water problem. The State should seize this present opportunity to mark out a policy with respect to its waters which shall establish once and for all the principles and procedure for their use and control, whether for municipal or power purposes, or for securing the incidental benefits to navigation and to the public health and safety which are sure to result.

NEED OF A PUBLIC POLICY.

The importance of a fixed policy established and announced by the State in the matter of water conservation cannot be overestimated. Without it, there is no place for consecutive and correlated action, either executive or legislative. In the past the

State has had no policy of power development, either under public ownership or by encouragement and regulation of private or corporate development. Unlike many other States, New York has never, under general laws, granted the right of eminent domain to individuals or corporations for the purpose of flooding lands to create storage ponds and develop waterpower. Moreover, it must be conceded that in view of the doubtful constitutionality of the " mill acts " of other States, and particularly in view of the strength of the modern sentiment demanding universal sharing in the benefits of natural resources and co-operation in their development, this State is not likely in the future indiscriminately to grant its power of eminent domain for this purpose. Unless the State shall define its policy and enter upon the work of carrying it out, this feature of its natural resources must largely remain in its present undeveloped condition, or be subject to the same haphazard and uncontrolled methods of utilization that have governed in the past. If we are to permit private interests to build storage reservoirs for power purposes on any large and satisfactory plan it can only be done by amending the Constitution, and even then, in the light of the decision of the Court of Appeals in the Matter of Tuthill, 163 N. Y. 133, the effort to adopt such a policy would be more than likely to prove a failure. As adequate reservoirs cannot be generally constructed for power purposes by private enterprise without constitutional amendment, and possibly not then, the better way to accomplish this object is for the State itself to announce its policy and undertake its performance in the interest of all classes and citizens. Whether that can be done by the passage of a general law, or whether it also requires a constitutional amendment, will be discussed further on.

If the scientific, economic and sanitary necessity of an intelligent, progressive, and comprehensive system of water storage is conceded, it is now in order to consider the proper means and agencies for its accomplishment.

IMPORTANCE OF STATE CONTROL.

In urging at the time of its last report the adoption by the State of a comprehensive public policy of water storage, the Commission discussed some of the more specific reasons why it is believed that such a program of reservoir construction should be undertaken by the State in the public interest. These reasons may be summarized as follows:

Development by the State ensures the fullest possible utilization of the power possibilities of each stream, whereas development by uncontrolled private enterprise often involves waste of resources. Private capital, seeking the greatest possible immediate return on the investment, naturally confines its attention to the most concentrated portion of a given fall. The less precipitous portions of the fall above and below, involving a large unit outlay in development, are consequently apt to be neglected and in too many cases permanently wasted, because no other enterprise is likely to undertake their development afterward, even if the rights of the company already on the spot would permit this to be done. On the other hand, the State, with its greater power and scope, and with financial resources enabling it to defer the return on its investment, could undertake the construction of the more extensive works necessary to develop the full extent of the fall in the supposed case. Without amplifying the point, it should be clear that the State is the only authority with sufficient power to insure the complete development of each and every stream so that every foot-pound of energy represented by its falling waters may be given up when necessary to the service of man.

The financial strength of the State enables it to undertake the large outlay involved in reservoir construction at much lower rates of interest than any private corporation, individual or association could hope to command. While credit is not money in the real sense, it is an important factor in financial enterprises, and in proportion as the credit of the State is better than the credit of private enterprises, the State is better equipped to develop its own resources. It would be practically impossible for a person or corporation to raise, without the use of bonds based on its credit, a sum sufficient to build the great reservoirs needed for stream control. An individual or corporation would be obliged to issue a 5 per cent. or possibly a 6 per cent. bond, and if a 5 per cent., to put it on the market at 85 or 90 per cent.

of its par value. On the other hand the State can float its 3 or 3½ per cent. bonds at par. The 6 per cent. which a private enterprise would have to pay as the fixed interest charge upon its original investment would pay the 3½ per cent. interest on the State investment and in addition provide a sinking fund that would retire the bond issue in less than twenty-five years. Such an advantage in favor of State construction and ownership cannot be overlooked.

Some of this very saving probably would and certainly should be used, in case the State does the work, to insure that degree of care in the planning and construction of dams, reservoirs and appurtenant works which is necessary to render these structures worthy of the State from an esthetic point of view. At any rate this object must be attained. Only under State control can the people of the State be absolutely safe-guarded in their right to have the natural beauty of their streams and lakes maintained at the highest degree consistent with the necessary and proper measures for regulation of flow and utilization of fall.

Even if private enterprise were in as strong a financial position as is the State, it has not the necessary authority to undertake river regulation on a large scale. Aside from the fact that under the laws of the State the power of eminent domain cannot be granted for this purpose, the proper construction of a great controlling reservoir is beyond the scope of any one individual, company or even association. Moreover, as all the developments on the stream receive the benefit of control, mutual action is a necessity. But mutual action and the distribution of costs and benefits in such a work has been shown by experience to be peculiarly difficult to arrange. Since individual development must of necessity be selfish in its purpose and limited in its extent, constant friction is likely to prevail not only between the different developments on a given stream but between their collective interests and that of the public. Under such conditions the incidental value of stream regulation for other public purposes, such as the prevention of floods, the dilution of sewage, the improvement of navigation and the protection of municipal water supplies, would inevitably fail to receive just and proper consideration.

State control means the careful utilization of each stream under a pre-established plan by which growing needs may be progressively met without impairing the eventual completeness of the development. With such a predetermined plan the State will be able to take into consideration many other factors in its public economy. With the possible future storage needs of a watershed in mind, the State can easily prevent the location of railroads, buildings and other structures at points where in the future they would have to be removed at great expense and trouble to make way for storage reservoirs. A specific instance in this connection has already been discussed in this report in speaking of the Salmon river.

In addition to the reasons for State control above enumerated, there is the need of supervision over the construction of dams to ensure their safety. No one will doubt that under State construction every precaution to secure the stability and safety of these structures will be taken. There are too many cases where private enterprise, with its eye on the immediate outlay, is tempted to save expense by the use of methods and materials which a proper consideration for public safety would not countenance. Frequent reports of disasters from the giving way of particular dams have aroused such wide-spread apprehension regarding all dams as will with difficulty be allayed even by insistence upon State control. Yet the construction of thoroughly safe dams, of which there are many notable examples, is only a matter of adequate expenditure and the proper supervision of designs and construction. In the State, if anywhere, must be found the authority which will insist on the use of methods and materials which shall provide the required factor of safety.

The prime inclusive reason for the exercise of State authority over the control of stream flow for power development is that under modern social and economic conditions this step is necessary to ensure the equal participation of all citizens in this form of natural wealth, which is peculiarly the heritage of the whole people. Some of the more particular supplemental reasons for State control have been mentioned in the foregoing. It appears that from all points of view the State is the proper authority to undertake and carry out the conservation of its own water re-

.sources. The advantages to be gained by the State in dealing with this natural resource have been forced upon the public mind none too soon. Even though the profits over and above interest, sinking fund and maintenance charges may not appear generous in the near future, our own experience and the experience and observation of our neighbors show that in the not distant future ample returns will result from all reasonable outlay. The next generation will either commend our efforts for prompt action or condemn us for inexcusable delay. Our ancestors found unlimited resources, immense forests which held the deep snows and heavy rainfalls in the strong grasp of their shadows, roots and tangled undergrowth, and permitted them to escape in slow and easy stages all through the dry summer months. The necessity for storage and stream regulation was unknown to them. They did not dream of the possibility of converting their water power into electricity and transmitting it long distances, nor did early industrial and social conditions supply a general market for power at large centers of population. To clear the land was their first effort; to remove the timber and make room for their homes was the ambition of the hardy pioneers. It seemed to them that the streams issuing from the deep, dark forest would run on through the future as they had been running in the past. We of modern times are met with new conditions and must solve new problems. The forests, to a large extent, have been felled or the fires have destroyed them. The flow of our streams is now more than ever irregular and unreliable, and unless regulated by storage, their value for power purposes is in a large measure lost, while at the same time there is a growing demand for power. The times demand early action and the State is the authority to which the people must look for relief.

It does not seem to this Commission that it should be necessary further to urge upon the State the importance of conserving its natural resources. It should be sufficient simply to point the way, so that the Legislature with the prevision of statesmen may adopt the necessary measures. We have no hesitation in saying that the regulation of stream flow and the general conservation of the State's water resources is a State function, and that this

State should continue to lead all others in so important a matter by enacting the required legislation, and, if necessary, by amending its fundamental law.

STATE LANDS REQUIRED.

Conservation of the water resources of the State on a broad and comprehensive plan which shall give practical consideration to the best opportunities and produce the largest amount of available power for market, necessarily involves the flooding of relatively small areas of State lands in the Adirondacks. In the last progress report, at page 232, the Commission stated as its preliminary estimate that only 20,000 acres of State land would be required for the building of a complete system of storage reservoirs on the Hudson, Schroon, Sacandaga, Beaver, Raquette and Saranac rivers.

The question of flooding State lands even for a public purpose is so important that the Commission decided that further surveys should be made, including all streams issuing from the Adirondacks, before making final recommendations upon this subject. Such surveys were accordingly made during the past year to determine as nearly as possible the total number of acres of State land that would be flooded or involved in the construction of reservoirs under a complete system of storage on all the principal Adirondack streams. These surveys and estimates indicate a total of 55,000 acres of State land of every description which would be required. This is a most exhaustive figure, including many reservoirs likely to be built only in the distant future, if ever; others which would not be built in case of the construction of alternative reservoirs on the same stream, and also taking into account State lands under waters already stored for regulation purposes. Even this total of 55,000 acres is only 3.9 per cent. of the State's holdings in the Adirondacks. Of this amount about four-fifths, is low and swampy land or, as in the case of the 9,680 acres on the Black and Oswegatchie rivers, is already under water. Only 11,000 acres of the State lands involved or less than eight-tenths of 1 per cent. of the State land in the Adirondacks, is timber land of value for forest purposes. As will be seen by the table in the accompanying report of the consulting engineer, only 29,085 acres would be required for the construction of all the reservoirs likely to be needed in a practicable regulation of the principal streams for the next ten or twenty years.

The diagram opposite this page shows in graphic form the relation between the amount of land which would be required within the Adirondack Park for a complete storage system and the total area and also the area of land within the park limits now owned by the State.

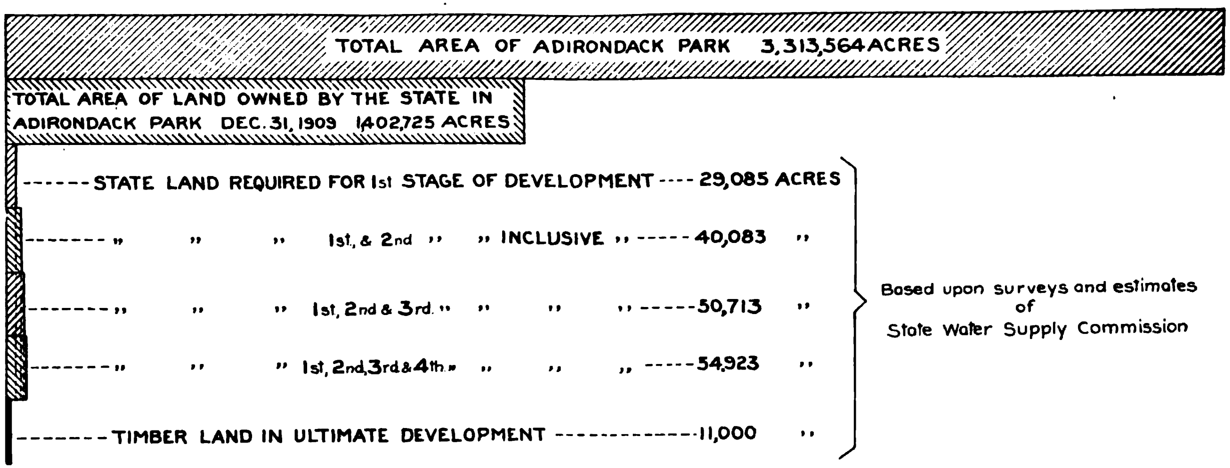
On page 180 below, in the Consulting Engineer's report is a detailed statement showing the different watersheds considered within the Adirondack region, the location of proposed and alternate reservoirs, the total number of acres of land that would be flooded or involved and the total number of acres of State land that would be flooded or involved in reservoir construction.

The studies and estimates made during the past three years by this Commission, which now cover the entire State, lead to the conclusion that these final estimates are ample to cover a most complete system of storage reservoirs in the Adirondack region, including the watersheds of the Black, Oswegatchie, Grass, St. Regis, Salmon, Chateaugay and Ausable rivers in addition to the Hudson, Raquette, Saranac and Beaver rivers included in last year's studies. In recommending the construction of reservoirs for the highest possible development of all rivers issuing from the Adirondacks, the Commission has no hesitation in asserting that the State in carrying out this project may safely put a limit on its own action by providing that not more than 43,500 acres of land now in possession of the State shall be flooded.

This comparatively small area of land stands in the way of a great public improvement. The State is now without the power to build storage reservoirs that would flood State lands. It is unwise to grant this privilege to individuals. Hence the question arises: Shall the Constitution be amended so that the State can use its own property for its own purpose?

In order to prevent any improper or wholesale flooding of State lands, it is important that any amendment to the Constitution should be thoroughly studied, carefully considered and so clearly expressed as to prevent any possible violation of its purpose, such purpose being limited to the flooding of State lands by reservoirs built, owned and forever controlled by the State. Such an amend-

Plate 3



STATE WATER SUPPLY COMMISSION
OF
NEW YORK.

DIAGRAM SHOWING COMPARATIVELY SMALL
AMOUNT OF STATE LANDS REQUIRED
FOR A
COMPLETE SYSTEM OF STATE STORAGE RESERVOIRS
IN THE
ADIRONDACK PARK.

JANUARY, 1910.

Walter McCulloh
CONSULTING ENG'R.

~~~NOTE~~~
State Land in this diagram refers to land in the possession of the State of New York on the 31st day of December 1909
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ment might refer to the several reservoirs stated above and limit the lands to be taken in each instance to a specified number of acres, or, as suggested in the report of the Consulting Engineer at page 185 below, the amendment might provide that the land to be so utilized by the State should not, at any time, exceed 2 per cent. of the State's holdings within the boundaries of the Adirondack Park. Further provision might well be made that whenever a reservoir is constructed by the State, which involves the taking of any State land, the actual cost of the portions taken shall be considered a part of the cost of the project and included in the estimate thereof. When the reservoir is built, a sum representing the cost of the State land taken might then be transferred from the water storage fund, as hereinafter provided for, to any fund of the State authorized to be used in the purchase of new forest lands, and the Land Board required to purchase with such funds, land of equal value elsewhere in the Adirondacks to be added to the forest preserve. The ultimate working out of such a policy would insure a considerable increase in the value and attractiveness of the forest preserve, since in practically all cases it would effect the substitution of lands of much greater value for forest and park purposes in the place of the low and swampy lands which would be converted to water storage purposes.

In view of the revenue that will accrue to the State by the adoption of a general and systematic plan for the development of its water resources, we recommend that the State Constitution be amended with the care as above stated, so as to permit the State to flood State lands in building storage reservoirs to be owned and forever controlled by the State.

CONSTITUTIONAL ASPECTS OF STATE CONTROL.

As we have already seen, no time need be spent upon the question of giving the right of eminent domain to a private enterprise to construct storage reservoirs for power purposes. The courts of our State and the Federal authorities agree that the Constitution of both the State and nation prohibits the taking of private property for private use, even though full compensation is paid therefor.

The real question to consider, however, is, when can the State take private property by the exercise of eminent domain? It must be conceded that the State, having parted with all of its land holdings in those regions where reservoirs can be economically built, except the forest preserve, must acquire anew by purchase or the exercise of the right of eminent domain, such tracts of land as may be necessary, if it is to enter upon a broad plan of water conservation. It is equally clear that the State itself, cannot take the property of one of its citizens for any other than a public use or purpose. It becomes, therefore, important to inquire (1) what is a public use or purpose as the term is employed in the State and Federal Constitutions, and (2) is the building of storage reservoirs for power and stream regulation such a public use or purpose?

In considering the first question, we naturally look for the definition of the phrase "public use" or "public purpose" as used in Section 6 of Article 1 of the State Constitution, and of the phrase "without due process of law" as used in the fourteenth amendment of the Federal Constitution and in Section 6 of Article 1 of the State Constitution.

Applying our common definition of the term, it may be said that a "public use" or "purpose" as referred to in our Constitution is a use in which all of the people in the State may participate, either in the actual enjoyment or occupation of the property taken, as in traveling on the highways, or in sharing in the receipts derived from the use or occupation of the property taken, as in the tolls received from the canal. A "public use," in a word, is a use that is within the scope of a legitimate governmental function.

So far as our research has gone, we have been unable to find in the writings on public law a wholly satisfactory definition of "public use." The phrase does not easily admit of a precise definition. Its meaning is so dependent upon the changing conditions of society that it cannot be confined within precise limits. It requires a certain degree of elasticity in order to meet the "new conditions and improvements and the ever-increasing necessities of society. The sole dependence must be on the personal wisdom of the sovereign authority, supervised, and in cases of gross error or extreme wrong controlled, by the dispassionate judgment of the court." (Olmstead v. Camp, 33 Conn. 532.)

Under the head of "Benefit or Good of Public," in "Words and Phrases," Volume 6, page 5828, we find the following:

"A historical research discloses the meaning of the term 'public use' to be one of constant growth. As society advances, its demands upon the individual increase, and each demand is a new use to which the resources of the individual may be devoted."

Tiedman, in his work on State and Federal Control of Persons and Property, says at pages 692 to 694, that "the ever-increasing complications of modern civilization have compelled an application of the right of eminent domain to other than public or governmental uses, and the meaning of the term 'public' was broadened from time to time in order to cover these new applications of the right, until now the term is synonymous with public good."

In speaking of what constitutes a "public use," as the term is used in the law of eminent domain, Mr. Justice Cooley, in his "Constitutional Limitations," page 532, says: "The reason of the case and the settled practice of free government must be our guide in determining what is or is not to be regarded a public use, and that only can be considered such where the government is supplying its own needs, or is furnishing facilities for its citizens in regard to those matters of public necessity, convenience or welfare which, on account of the peculiar character, and the difficulty, perhaps impossibility, of making provisions for them otherwise, are alike proper, useful and needful for the government to provide." This statement of Mr. Justice Cooley was approved in Overman Silver Mining Company v. Corcoran, 15 Nev. 147.

The phrase "public use," in the law of eminent domain, does not necessarily mean that the improvement should directly benefit the people of the whole State, but the direct public benefit contemplated may be confined to a particular community.

Natural Gas Light Co. v. Richardson, 63 Barb. 437, at page 448.
Stamford Water Co. v. Stanley, 39 Hun 424.
Inhabitants of Wayland v. Middlesex County Commissioners, 79 Mass.; 4 Gray, 500.
Pocantico Water Works Co. v. Bird, 130 N. Y. 249.
Matter of New Rochelle Water Co., 46 Hun 525.
St. Helena Water Co. v. Foster, 62 Cal. 182.

It is said in Talbot v. Hudson, 82 Mass, 417–425, 16 Gray 417, that, " In determining whether the use is public, it has never been deemed essential that the entire community or any considerable portion of it should directly enjoy or participate in the benefits to be derived from the purpose for which the property is appropriated. It is enough if the taking tends to enlarge the resources, increase the industrial energies, and promote the productive power of any considerable number of the inhabitants of a section of the State or leads to the growth of towns and the creation of new channels for the employment of private capital and labor. Such results directly contribute to the general welfare and prosperity of the whole community."

In view of these definitions, we must come straight to the proposition whether the real purpose of water storage is a public one or whether it is so alleged as a mere subterfuge. If it is a real public use, then, in the judgment of this Commission, the State can pass a law that the courts will uphold, provided it complies with the " due process of law " condition of the Constitution. We may, therefore, in defending our position, again very properly refer to the history of the legislation leading up to the question under discussion.

The words of the Governor in his message of 1907, which gave the initial impetus to the present investigation, left no doubt as to its public purpose. He said, in discussing the State forest reservations:

> " In this connection it is well to consider the great value of the undeveloped water powers thus placed under state control. They should be preserved and held for the benefit of all the people and should not be surrendered to private interests. It would be difficult to exaggerate the advantages which may ultimately accrue from these great resources of power if the common right is duly safeguarded."

Referring to the existing powers of the State Water Supply Commission, he added:

> " It remains to be considered whether it is not advisable to provide a more comprehensive plan, embracing in a clearly defined way the matter of water storage and the use of water

> courses for purposes of power. The entire question of the relation of the state to its waters demands more careful attention than it has hitherto received in order that there may be an adequate scheme of just regulation for the public benefit."

Next came the enactment of chapter 569 of the Laws of 1907, in which the Legislature in section 1 of that act uses these words:

> "The State Water Supply Commission is authorized and directed to devise plans for the progressive development of the water powers of the state under state ownership, control and maintenance for the public use and benefit and for the increase of the public revenue."

And again in section 4, it said:

> "If any plan devised by the Commission shall include the construction of a dam or dams upon any river or water course, the Commission shall ascertain and report as nearly as practicable * * * the probability of selling such power, and the probable gross and net revenues from both direct and indirect sources which would be derived from the sale of such power at such proposed dam."

Again in section 10 of the bill:

> "The Commission in its final report shall also include the draft of a bill for a general law providing for carrying its recommendations into effect * * *. Such bill shall include a financial plan providing for the issue of the bonds of the state in such amounts as may be required for paying the cost of the water power development to be made."

There is, beside these direct expressions of the law-making power of the State, the general consensus of opinion that the wasted flood waters should be conserved, that such conservation is a governmental function, and that such waters should be stored and controlled in a manner that will provide a revenue to the State. In all the studies and investigations of the Commission it has kept steadily in mind these commands of the statute to devise a plan for the progressive development of the waterpowers of the State for the *public use,* under State ownership and control. In the draft of the bill which is to accompany this report the title not only adheres to the object as declared by the statute authorizing it, but its every essential feature depends on the fundamental assumption that the building of the proposed storage reservoirs is for a *public purpose only.*

It must, therefore, be apparent that in all of the proceedings leading up to this proposed legislation and *in the legislation itself,* the State has been the actor. The facts are thus brought clearly within the dictum of Judge Gray, at page 143 of the opinion in the Matter of Tuthill, 163 N. Y. 133, where he says, referring to the case of People ex rel. Cook v. Nearing, 27 N. Y. 306. "The state was the actor in the matter and thus the presumption of a public purpose was conclusively furnished." Although this expression may not have been necessary in reaching a decision in that case, it is nevertheless a correct statement of the law as it actually exists.

It appears from the studies already made by this Commission as heretofore stated that nearly 1,000,000 horsepower of water energy is running to waste in the State and that this water power has a yearly rental value of at least $10,000,000 when properly controlled. There is a growing demand by the public for such control and also a growing market for its use. The ability to transmit electricity and the constant multiplication of its uses as constantly increases the market demand. For interest charges on the costs of construction, maintenance and operation, $3,000,000 per year is a large allowance, leaving a net annual value of $7,000,000, which might be reclaimed from this waste product of nature. The State and its citizens would be in this way directly benefited. The indirect benefits to the State will be much greater. Counting the families of those to whom employment will be afforded and the storekeepers, farmers, mechanics, and business and professional men indirectly supported, it may be safely said that at least one person is supported by every horsepower developed. The same point is illustrated in another way by the towns that spring up and flourish at every water power site. Thus the 1,000,000 of horsepower added to our water powers will mean a living for 1,000,000 more people. It is, therefore, evident that the property necessary to house these people, the mills, factories and railways, etc., in which the power will be used all mean a wealth from which the usual contribution in taxes will indirectly furnish an enormous income to the State. To be definite, these 1,000,000 people will pay in State, city, town, county, school and special taxes at usual rates, $16,000,000 yearly. Here is the question then: Shall the State remain passive and ultimately allow this priceless possession of water power to remain unused or shall it in the march of civilization keep step with new demands and new conditions? The passage of a law that permits the use of a natural resource for new purposes is well within the general definition of public use as established in various decisions of the courts. Building a storage reservoir will stimulate industrial energy and promote the productive power of a very large population in the portion of the State affected, besides leading to the growth of towns and the creation of new channels for the employment of capital and labor in those other centers, as well as in places to which electrical energy can be carried. So all over the State industrial opportunities are waiting for a strong and skilful hand to apply the electric spark that will set in motion many hands and wheels. A general policy for the systematic development of the State's water resources would quickly become an important factor in the general welfare of all our people and, therefore, has a real "*public purpose.*" Such a general policy is in harmony with the true spirit of representative government. The value of the flood water of the rivers of the State for power and navigation purposes has only been brought to general attention within the past few years. The policy of the State in attempting to turn these wasted waters into a perpetual income is a new departure in State legislation which has grown out of the general advance of electrical and hydraulic science, the progress of modern business activities and the state of the public mind in regard to the further development of natural resources. The fact that the causes making this a "public purpose" may have arisen since the constitution was written, does not affect the constitutional validity of such action by the State under modern conditions.

But the people are not without the means of relief in the face of this economic necessity even if the foregoing argument should fail at every point. Should the courts finally say that under the Constitution the building of reservoirs by the State as herein recommended is not a public purpose, then certainly we as a State have begun the study of this subject none too soon. It would immediately become our duty to follow the example recently set by the Swiss republic when it saw its splendid water resources running to waste with no power in the cantons to conserve and control them. We should amend our Constitution as they did theirs, in order that the State's water power resources may be developed systematically for the benefit of the people of the State.

AMENDMENT OF THE CONSTITUTION TO PERMIT WATER STORAGE BOND ISSUE.

The manner of procedure in the plan for a general and systematic development of the water resources of the State should, if possible, be worked out under existing laws. If it is found impossible to make substantial progress under the laws as they now exist, the objections should be pointed out and amendments made that will permit the State to enter upon such a public policy.

Section 4 of article VII of the State Constitution prohibits the Legislature from making an appropriation of more than $1,000,000 per year for the purpose of carrying out any general public policy such as is recommended herein.

The construction of a reservoir unit under the proposed policy will cost, in some instances, four or five times such sum and it becomes necessary to provide means to build such a reservoir. We, therefore, again recommend an amendment to the Constitution in substantially the following form:

Section 1. Resolved (if the Assembly concur), That the seventh article of the Constitution be amended by adding thereto the following section:

§ 13. A debt or debts of the State may be authorized by law for the improvement of rivers by the building of storage reservoirs for the public welfare. Such rivers shall be determined under general laws. The aggregate of the debts authorized by this section shall not at any time exceed the sum of $20,000,000. The payment of the annual interest on such debt and the creation of a sinking fund of at least 2 per cent. per annum to discharge the principal at maturity shall be provided by general laws whose force and effect shall not be diminished during the existence of any debt created thereunder. The Legislature may by general laws provide for the sale or lease of the privilege of using the waters made available from such improvement or from the sale of, lease or rent of the mechanical, electrical or other energy that can be developed therefrom. None of the provisions of the fourth section of this article shall apply to debts for the improvement of rivers hereby authorized.

ALTERNATIVE THEORIES OF STATE CONTROL OF WATER STORAGE.

The proposals which have been made to build the Portage and Sacandaga reservoirs under the river improvement law bring out an issue which the people of the State must determine, namely, whether these great projects are to be contsructed under new and special legislation placing them frankly on the basis of water-power development for a public revenue, or whether storage reservoirs with the real object of power development shall be built under the present river improvement law, where the declared purpose is the benefit of the public health and safety, and the work is to be paid for by issuing bonds which shall be a lien upon the property benefited.

If the State does the work as a part of a general and systematic State policy for the purpose of obtaining a revenue, under the plan submitted herewith, it becomes the owner of the reservoir and works, and it will be entitled to receive the revenues derived therefrom. But if the reservoir and works are constructed under the river improvement act and paid for by the owners of property and municipalities benefited, the State will have no part in the direct benefits to be derived from such reservoirs although the reservoirs will become and remain a substantial benefit to the power owners.

It is, therefore, clear to this Commission that the Genesee, Hudson and other rivers should be improved for power purposes under the plan we have suggested rather than under the river improvement act.

DEVELOPMENT PLAN SUGGESTED BY THE COMMISSION.

All that has been said about the State's water resources, their importance as a stimulus to industrial progress and their money value, call upon us to devise a working plan for their development.

Gathering the facts and putting them in readable form has merely required patient work along well developed lines. In devising a practical plan to turn this wasted element into useful energy, however, we must blaze a new trail and enter new fields. Engineering and hydraulic science has pointed out where artificial reservoirs can be built and how they can be operated to regulate the flow of streams, to utilize their power, and to beautify their surroundings. This, we have shown, can be done by creating artificial lakes at many points and upon many different streams, and it should be done by the State.

The work should be begun by selecting the site which gives the best promise of financial returns. In the selection of that site both the State and owners of property that will be benefited by the regulated flow of the river should be consulted.

The Commission has incorporated its proposed plan in a bill which provides for a general and systematic conservation development and regulation of the water resources of the State. The draft of this bill follows this report and forms a part thereof.

Its first section defines the words "reservoir," "power" and "Commission" as used therein.

Sections 2 and 3 provide that the initiative for building storage reservoirs may be taken by individuals, associations or corporations subject to the recommendations of the Commission and the approval of the Governor.

Section 4 permits the Commission to adopt rules and regulations covering the form of petitions and guarantees.

Sections 5 and 6 provide for initiative by the Commission, subject to the approval of the Governor, and of the State Engineer and Surveyor and the Canal Board, if canal waters are affected.

Section 7 permits material changes in maps, plans and specifications only upon approval by the Governor.

Sections 8 to 14, inclusive, are devoted to the detail of acquiring lands and of the construction of the reservoirs. In the matter of letting contracts and in the details of construction, the Barge Canal Act has been consulted as a model.

Section 15 requires that all contracts shall have the approval of the Governor.

Section 16 permits the Commission to make rules and regulations for the operation, maintenance and control of the reservoirs when built.

Section 17 authorizes the Commission (for the purpose of providing a revenue to the State) to sell or lease the use of water stored in any reservoir and to sell or lease power that may be developed thereby, and

Section 18 authorizes the Commission to make contracts for the payment of the amount of yearly benefits conferred by reason of regulating the flow of the water in any stream upon which reservoirs may be built.

Sections 19 to 24, inclusive, for the purpose stated above, provide the manner of assessing and collecting yearly benefits where contracts are not made.

Section 25 provides for the establishment of a State Water Storage Fund and defines the purposes for which it may be used.

Section 26 empowers the Commission to engage the necessary engineers and others to carry out the provisions of the act.

Sections 27 and 28 provide for a bond issue to raise the money necessary to carry on the undertaking and, as required by the Constitution, for the levy of a tax for the payment of such bond issue, and finally,

Section 29 directs that the provisions shall be submitted to the people for approval by a majority vote before taking effect. This is necessary because of the requirements of section 4 of article 7 of the Constitution of the State.

It has been the purpose of the Commission, in drafting this proposed bill for a general and systematic development of the water resources of the State, to devise a plan which, when perfected and put into operation, will yield a net revenue and conserve, in the interests of the general welfare, a great natural resource, now largely running to waste. We fully realize the importance of this step the State will take in adopting as a fixed policy the plan outlined. We also realize that it may arouse opposition, but, as it is a proposal to do that which no person, association or corporation can do, as it will create and turn over to capital and labor alike, a wasted force to be used for their mutual benefit, such opposition to the general features of the proposed measure must, after careful study of all its provisions and purposes, disappear. Those who now feel justified in waging opposition will come to approve of this policy as a wise and prudent step in the interests of the State, and all its industries and people. The plan permits the present generation to use its own and saves for future generations that which is justly theirs. Such a policy will have a wholesome and beneficial bearing upon every interest affected by the conservation movement. *It will establish the broad and deep principle that controlling the greatest and cheapest source of power, falling water, is a governmental function.*

We do not presume that the accompanying bill is perfect, neither do we assume that it will not be necessary to revise it in many essentials; but we do present it as the Commission's contribution to the discussion of a subject that should receive the careful attention of the Governor, Legislature and publicists.

RECOMMENDATIONS.

We, therefore, recommend the following:

(1) For the purpose of providing a general and systematic plan for the development of the water resources of the State, the enactment into law of the bill accompanying this report.

(2) The amendment of the Constitution so as to permit the flooding of State lands in building storage reservoirs by the State, said reservoirs to be forever owned, maintained and controlled by the State for the purpose of providing a public revenue. Such amendment should be so worded as to prevent the flooding of State lands for any other purpose whatever.

(3) An amendment of the Constitution providing for a bond issue for the purpose of building reservoirs by the State under the conditions mentioned in the foregoing recommendation.

(4) As the first unit in the general plan of development, the construction by the State of a storage reservoir upon the Sacandaga river at or near Conklingville, substantially according to the plans prepared by this Commission, for the purpose of regulating the flow of the Hudson river, for power development and flood control; such reservoir to be owned, maintained and controlled by the State so as to produce a net revenue. That work be begun thereon as soon as the interests which will be benefited by such river control shall petition for the building of such reservoir and shall furnish a sufficient guarantee that such reservoir when completed will provide a net revenue for the State.

(5) That other reservoirs be built by the State for the purpose of regulating the flow of the rivers for power purposes and flood control, whenever the interests which will be benefited by such control shall petition the State Water Supply Commission to build such reservoirs and furnish a sufficient guarantee that such reservoirs when completed will provide a net revenue to the State.

(6) That appropriation be made for the purpose of continuing detailed studies of the water resources of the Oswego, Black and other rivers.

(7) That an appropriation be made for the purpose of continuing and extending stream gaging work in co-operation with the United States Geological Survey.

CONCLUSION.

The Commission realizes that during the past three years it has been working in an entirely new field. Earlier investigations may have touched certain aspects of the subject, but none has previously been made in the spirit and from the point of view of the present study. The endeavor has been made to meet the spirit of the Fuller act and present to the Governor and Legislature the facts concerning the water powers of the State and the possibilities of their development in the interest of the people. The foregoing report and the earlier progress reports do not contain all the information there is to be had upon the subject, neither does the Commission assume that its plan for the general conservation of the State's water resources cannot be improved. It does believe, however, that the information that has now been obtained and recorded will help those in official position to solve the problem of conserving a great natural resource in such a way that all citizens of the State may share in its benefit.

All of which, together with the draft of the proposed bill as required by chapter 569 of the Laws of 1907, and the reports of our engineers, which are transmitted herewith and form a part of this report, is respectfully submitted.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

DRAFT OF BILL FOR GENERAL LAW
TO PROVIDE FOR CONSERVATION OF WATER RESOURCES
FOR THE PUBLIC USE AND BENEFIT.

STATE WATER SUPPLY COMMISSION.

DRAFT OF BILL FOR GENERAL LAW TO PROVIDE FOR CONSERVATION OF WATER RESOURCES FOR THE PUBLIC USE AND BENEFIT.

AN ACT to provide for the general and systematic conservation, development and regulation of the water resources of the state for the use and benefit of the people of the state; defining procedure and prescribing penalties; providing for issuing bonds to an amount not exceeding twenty million dollars and for a submission of the same to the people to be voted upon at the general election to be held in the year nineteen hundred and ten.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. **Definitions.**— (a) The word "reservoir" when used in this chapter shall be interpreted to include the dam and all of the appurtenant structures and appliances connected therewith, the lands under the water impounded before and after the construction of the dam, and such lands surrounding the dam and the water impounded, as the commission may determine to be necessary for the construction, maintenance and operation of the reservoir.

(b) The word "power" when used in this chapter shall be interpreted to mean the energy derived from falling water at a reservoir, or at any other place within the state below a reservoir, and any and all forms which such power may assume in its development, transmission or transformation.

(c) The term "real estate" when used in this chapter includes all uplands, lands under water, the waters of any lake, pond or stream, all water and riparian rights or privileges, all water powers, water plants, and all dams, races, sluiceways and machinery connected therewith, and any and all easements and incorporeal hereditaments, and every estate, interest and right, legal and equitable, in land or water, including terms for years, and liens thereon by way of judgment, mortgage or otherwise, and all claims for damages thereto, which may be acquired, purchased, leased, used or occupied by the state for the purposes of this act. It shall also be construed to include all real estate (as the term is above defined) heretofore or hereafter acquired or used for railroad, highway or other public purposes and which may be acquired, purchased, leased, used or occupied by the state for the purposes of this act.

(d) The words "commission," "commissioner" or "commissioners" when used in this chapter shall mean the State Water Supply Commission.

§ 2. Petition and approval when plans have been made and filed.—Any person may present a petition to the state water supply commission, requesting it to recommend the building by the state of a reservoir, specifying the place where such reservoir is to be constructed. Such petition shall be accompanied with evidence that such reservoir when built will produce an annual revenue to the state by the sale or lease of the privilege of using the waters which can be stored therein, or by the sale or lease of power that can be generated thereby, or by assessments that can be made by reason thereof, and with a guaranty that the petitioner will pay yearly to the state a fixed sum which shall not be less than the amount mentioned in the petition as the annual revenue to be derived therefrom. In case maps, plans and specifications for a reservoir at or near the location of the proposed reservoir are on file in the office of the commission and if it appears therefrom that such proposed reservoir will form a unit in the plan for the general and systematic conservation, development and regulation of the water resources of the state, the commission, within thirty days from the receipt of such petition, shall either approve or reject such petition and give its reasons therefor. If the commission shall approve such petition, it shall present a copy of the same with its reasons for approval and with a copy of the maps, plans, specifications and estimates to the governor, who shall within thirty days after the presentation to him of such petition and report, if he approves the same, direct the commission to proceed, in the manner herein provided, to build a reservoir at the place named in said petition, and as near as may be according to the maps, plans and specifications on file in the office of said commission.

§ 3. **Petition and approval when plans have not been made; procedure.**— Subdivision 1. Whenever any person shall present a petition to the commission, requesting it to recommend the building, by the state, of a reservoir upon any of the rivers, streams, lakes or ponds of the state, which will when completed form a unit in a plan for the general and systematic conservation, development, and regulation of the water resources of the state, and which will in the opinion of the petitioners produce an annual revenue to the state by the sale or lease of the waters which can be stored therein or by the sale or lease of power that can be generated thereby or by assessments which can be made by reason thereof, and maps, plans and specifications for which have not been made and filed by the commission, the commission shall make an examination of the proposed reservoir site, and if it is satisfied that the development requested by such petitioner is feasible and one that will produce a yearly revenue to the state and if such yearly revenue shall be secured by proper guaranty by the petitioners, it may proceed to collect necessary information and to make the necessary borings, surveys, maps, plans and specifications for such reservoir and file such information, maps, plans and specifications with an estimate of the total cost of such a reservoir in its office, which information, maps, plans, specifications and estimates shall be open to public inspection.

Subd. 2. After such examination, the commission shall, within thirty days from the filing of such maps, plans and specifications, either approve or reject the petition and give its reasons therefor. If the commission shall approve such petition, it shall present a copy of same, together with its reasons for approval and with copies of the maps, plans and specifications, to the governor who shall, within thirty days after the presentation of such petition to him, if he approves the same, direct the commission to proceed in the manner herein provided to build a reservoir at the place named in such petition and as near as may be according to the maps, plans and specifications on file in the office of said commission.

§ 4. **Form of petition and guaranty.**—All petitions and guaranties shall comply in manner and form with rules adopted by the commission.

§ 5. **Construction without petition.**— Whenever its investigations show that a reservoir can be built upon any of the rivers, streams, lakes or ponds of this state, which when constructed will form a unit in the plan for a general and systematic conservation, development and regulation of the water resources of the state and when completed and operated will produce a yearly revenue to the state, the commission may present a request to the governor for authority and direction to build such reservoir. Such request to the governor shall be accompanied by an estimate of the total cost of such reservoir; copies of maps, plans and specifications; and a report upon the project including an estimate of the nature and amount of benefits that will be conferred upon private property and municipalities situate upon such river or stream below the location of such proposed reservoir and the total amount of the yearly income that the state may expect to receive therefrom. The governor shall, if he approves such request, authorize and direct the commission to proceed in the manner herein provided to build a reservoir at the place named in said request and as near as may be according to the maps, plans and specifications on file in the office of said commission.

§ 6. **Procedure where canal waters may be affected.**— Whenever any of the plans to be forwarded to the governor for approval affect streams whose waters are used for canal purposes, copies of the maps, plans and other documents shall be first forwarded to the canal board, who shall within one month after the receipt examine and return same to the commission with a report upon the relation of the project to the canal waters and such recommendations, if any, as they shall consider necessary for the protection of the water supplies of the canals of the state. The commission shall then further proceed as hereinbefore specified, and shall include among the documents forwarded to the governor the report and recommendations of the canal board.

§ 7. **Modification of plans, how made.**—Any change or modification of any such maps, plans and specifications that will increase the total cost of any such reservoir more than fifteen per cent. above the estimates of the cost of the project as approved by the governor and on file in the office of the commission, not including land damages, must be approved by the governor.

§ 8. **Land maps to be filed.**— Upon the maps specified in sections two, three, and five of this act, there shall be laid out with the names of the owners, and numbered, the various parcels of land that in the opinion of said commission will be required for building, maintaining and operating such reservoir, or which in its opinion may be necessary for the prosecution of the work contemplated by this act. The said commission shall file in the office of the county clerk of the county wherein the same is situate, a certified copy of the maps, showing the location of such parcels of land.

§ 9. **Acquisition of real estate; right of entry.**— It shall be the duty of said commission and it is hereby authorized to acquire from time to time, and in the manner hereinafter stated, in the name of and for the state, such real estate as said commission may determine to be necessary for the purposes of this act, and for such object, the said commission, its engineers, employees and representatives, may enter upon such real estate for the purpose of making all surveys, measurements and observations, and for obtaining such information and data as the commission may require.

§ 10. **Real estate that may be acquired.**— Said commission may enter upon and take possession of any real estate, the appropriation of which in its judgment shall be necessary for the purpose of carrying out the provisions of this act.

§ 11. **Real estate; certified descriptions; when state deemed owner.**— The said commission shall make a description of each parcel of the lands referred to on the maps, mentioned in section 8 of this act, which description shall be certified by the commission to be correct, and it shall endorse upon such certificate a statement that the lands described therein have been appropriated by the state for the purpose of a state storage reservoir, and it shall file such description and certificate in the office of the Secretary of State.

The said commission shall thereupon serve on the owner of any real estate so appropriated, a notice of the filing and the date of filing of such description and containing a general description of the real estate belonging to such owner which has been so appropriated; and from the time of such service, the entry upon and appropriation by the state of the real estate described in such notice, for the uses and purposes above specified, shall be deemed complete, and thereupon such property shall be deemed and be the property of the state. Such notice shall be conclusive evidence of an entry and appropriation by the state. The said commission may cause duplicates of such notice with an affidavit of due service thereof on such owner to be recorded in the books used for recording deeds in the office of the clerk of any county of this state where any of the real estate described therein may be situated, and the record of such notice and of such proof of service shall be evidence of the due service thereof.

§ 12. **Acquiring title by agreement with owner.**— The commission may agree with the owner of any real estate so appropriated, upon the amount of compensation to be paid to such owner and for any damages resulting from such appropriation, or by the relocation or reconstruction of any railroad or highway. If any real estate of any county, town, school district or municipality is required by the state for the purpose of this act, the majority of the board of supervisors acting for such county, or the supervisor of any such town acting for such town, or the trustees of any school district acting for such district, or the mayor and common council of any city or president and board of trustees of any village, or other persons, boards or bodies having like power, acting for such municipality may grant or surrender such real estate for such compensation as may be agreed upon between such officers respectively and the state water supply commission, and the compensation agreed upon by the commission and such officers shall be paid by the state to the fiscal officer of the municipality or to the person from whom such real estate is purchased or acquired.

§ 13. **Presentation of claim to the Court of Claims.**— If the state water supply commission is unable to agree with the owner for the value of the property so taken or appropriated, or on the amount of damages resulting therefrom, such owner, within one year after the service upon him of the notice of appropriation as above specified, may present to the Court of Claims a claim for the value of such land and for such damages, and the Court of Claims shall have jurisdiction to hear and determine such claim and render judgment thereon. Upon filing in the office of the comptroller a certified copy of the final judgment of the Court of Claims, and a certificate of the attorney-general that no appeal from such judgment has been or will be taken by the state, or, if an appeal has been taken, a certified copy of the final judgment of the Appellate Court, affirming in whole or in part the judgment of the Court of Claims, the comptroller shall issue his warrant for the payment of the amount due the claimant by such judgment, with interest from the date of the judgment until the thirtieth day after the entry of such final judgment, and such amount shall be paid by the treasurer of the state.

§ 14. **Acquiring municipal or railroad property; procedure.**— The commission may agree with any duly incorporated railroad corporation or with any town for the land owned or occupied by such corporation as a railroad or by such town as a highway upon a line of relocation or a plan of reconstruction of such railroad or highway and may relocate or reconstruct such railroad or highway according to the terms and specifications mentioned in said agreement. If the commission is unable to agree with such company or town upon a line of relocating or a plan of reconstructing such railroad or highway, said commission may relocate or reconstruct said railroad or highway upon such a line and according to such a plan as it may determine to be just and fair to said railroad company or town. Such a corporation or municipality may present to the Court of Claims a claim for damages, if any, by reason of reconstructing or relocating such railroad or highway and the Court of Claims shall have jurisdiction to hear and determine such claim and render judgment thereon. Upon filing in the office of the comptroller a certified copy of the final judgment of the Court of Claims, and a certificate of the attorney-general that no appeal from such judgment has been or will be taken by the state, or, if appeal has been taken, a certified copy of the official judgment of the Appellate Court affirming, in whole or in part, the judgment of the Court of Claims, the comptroller shall issue his warrant for the payment of the amount due the claimant by such judgment, with interest from the date of the judgment until the thirtieth day after the entry of such final judgment, and such amount shall be paid by the state treasurer.

§ 15. **When costs may be awarded.**— If an offer is made by the said commission for the value of land appropriated, or for damages caused by such appropriation, or by the relocation or reconstruction of any highway or railroad, and such offer is not accepted, and the recovery in the Court of Claims exceeds the offer, the claimant is entitled to costs and disbursements as in an action in the Supreme Court, which shall be allowed and taxed by the Court of Claims and included in its judgment. If in such a case the recovery in the Court of Claims does not exceed the offer, costs and disbursements to be taxed shall be awarded in favor of the state against the claimant and deducted from the amount awarded to him, or if no amount is awarded, judgment shall be entered in favor of the state against the claimant for such costs and disbursements. If an offer is not accepted, it cannot be given in evidence on the trial.

§ 16. **Ascertainment and payment of liens.**— When a judgment for damages is rendered for the appropriation of any lands or waters for the purposes specified in this act, and it appears that there is any lien or incumbrance upon the property so appropriated, the amount of such lien shall be stated in the judgment, and the comptroller may deposit the amount awarded to the claimant in any bank in which moneys belonging to the state may be deposited, to the account of such judgment, to be paid and distributed to the persons entitled to the same as directed by the judgment.

§ 17. **Work to be done by contract; advertising; deposit, et cetera.**— Subdivision 1. Except as hereinafter provided, all the work herein specified shall be done and all material and supplies shall be procured under contracts executed in triplicate, and entered into by the commission, on the part of the state, after having been advertised once a week for four successive weeks in two newspapers published in the city of New York, one of which shall be published in the interests of engineering and contracting, and in one newspaper each in the cities of Albany, Rochester, Buffalo and Syracuse and one in each county where the particular piece of work advertised, or some portion of the same, is located. The advertisement shall be limited to a brief description of the work proposed to be let, with an announcement, stating where the maps, plans and specifications are on exhibition and the terms and conditions under which bids will be received and the time and place where the same will be opened, and such other matters as may be necessary to carry out the provisions of this act, or the commission may determine are necessary. The proposals received pursuant to such advertisements shall be publicly opened and read at the time and place designated. Every proposal must be accompanied by a money deposit in the form of a draft or certified check upon some solvent state or national bank in the city of Albany or New York, payable at sight to the state water supply commission, for at least five per cent. of the amount of the proposal. In case the bidder to whom such contract shall be awarded, shall fail or refuse to enter into such contract within the time fixed by the commission, such deposit shall be forfeited to the state, paid to the state treasurer and become a part of the state water storage fund. In case any bid shall be rejected, such deposit shall be returned to the bidder. In cases where the estimated cost of the materials and work does not exceed ten thousand dollars, the period of advertising may be abridged and the work may be advertised by circular letters and posters, when, in the judgment of the commission, such course may be desirable or necessary. The commission may reject any or all bids and readvertise and award the contract in the manner herein provided, whenever in its judgment the interests of the state will be enhanced thereby.

Subd. 2. The contract shall be in a form approved by the attorney-general, and shall be awarded to the person, firm or corporation offering to do such work at the lowest price, and who shall give adequate security for the faithful and complete performance of the contract within the sum specified in such bid, and such security shall be approved as to sufficiency by the commission, and as to form, by the attorney-general, and shall be in an amount equal to at least twenty-five per cent. of the sum at which such contract was awarded. If in the judgment of the commission, the work upon any contract is not being performed according to the contract or for the best interests of the state, it shall have power to suspend the work under such contract while it is in progress, and it shall thereupon become its duty to complete the same in such manner as will accord with the contract specifications and be for the best interests of the state, or the contract may be canceled and readvertised and relet in the manner above prescribed, and any excess in the cost of completing the contract beyond the price for which the same was originally awarded shall be charged to and paid by the contractor failing to perform the work. If at any time in the conduct of the work under any contract, it shall become apparent to the commission that any item in the contract will exceed in quantity the engineer's estimate by more than fifteen per cent. they shall so certify to the governor and the governor shall thereupon determine whether the work in excess thereof shall be completed by the contractor under the terms and at the prices specified in the contract or whether it shall be done or finished by the commission, or whether a special contract shall be made for such excess in the manner above prescribed. Every contract shall reserve to the commission the right to suspend or cancel any contract as above provided, and to complete the same or readvertise and relet the same as it may determine, and shall also reserve to the commission the right to enter upon and complete any item of the contract which shall exceed in quantity the engineer's estimate by more than fifteen per cent. or to make a special contract for such excess as it may determine.

§ 18. **Contracts, approval of.**— All contracts entered into by said commission for the state, pursuant to the provisions of this chapter, shall be subject to the approval of the governor, and when so approved, shall become binding upon the parties thereto.

§ 19. **Operation of Reservoirs; Powers of Commission.**— The commission is hereby authorized to make rules and regulations for the control, operation and maintenance of reservoirs, and to perform any and all acts proper to the enforcement of such rules and regulations, or necessary and proper for the purpose of carrying the provisions of this act into full force and effect.

§ 20. **Sale of water and power.**— For the purpose of providing a revenue for the state, the said commission is hereby authorized to sell or lease to any person, association or corporation, municipal or otherwise, for terms not exceeding (   ) years each, the water stored in any reservoir built by the state as herein provided, or to sell or lease the right to use said water or to sell or lease the power that may be developed thereby. The yearly sum agreed upon to be paid to the state for the lease or sale of such water or power shall be a tax upon the property benefited, municipal or otherwise, or upon the property used for the development or transmission of such power, and such sum shall be a lien thereon with the same effect as taxes, assessments and levies lawfully made. A copy of the agreement made by said commission for the sale or lease of such water or power, fixing the sum to be paid yearly by each person or corporation, shall be filed by said commission with the local assessors in the assessor's district wherein the property benefited, or where the power developed, is situate, and said assessors shall place the amount to be paid yearly on the assessment-roll opposite the property benefited or used under the head of "property benefited by water storage" and such sum shall be collected in the same manner as general taxes are collected and shall be paid to the treasurer of the county, and by him paid to the state treasurer to the credit of the state water storage fund. If such agreement is made with a municipality fixing the yearly amount to be paid by it for the advantages that may accrue to it by reason of the building of such storage reservoir, a copy thereof shall be filed with the chief fiscal officer of such municipality. The yearly sum fixed by such agreement shall thereupon become a tax upon such municipality. It shall be the duty of the officers of said municipality to raise yearly such sum of money in the manner in which the general expenses of such municipality are raised and pay the amount thereof yearly to the state treasurer, who shall deposit the same to the credit of the fund to be known as the state water storage fund.

§ 21. **Contracts with persons and municipalities as to benefits conferred.**— For the purpose of providing a further revenue for the state, said commission is authorized to enter into a contract with any person or corporation whose property is benefited by reason of the building of a reservoir, and the storing and controlling of waters, or with any municipality benefited by reason thereof. The sum so agreed upon shall be a tax upon the property and municipalities benefited, to be assessed, levied and collected in the manner provided in section 17 of this chapter.

§ 22. **Fixing yearly benefits.**— For the purpose of providing a further revenue for the state, the commission shall, after the completion of a reservoir, and every five years thereafter, assess the value of the yearly benefits conferred by the building and operating of any such reservoir upon the property and upon the municipalities benefited. The yearly sum so assessed shall be a tax upon each piece of property or municipality so benefited and become a lien upon such property and municipality with the same effect as taxes lawfully assessed and levied. When the assessment is made upon private property, the said commission shall file a statement of the amount of such benefits assessed by it as aforesaid with the local assessors in the assessors' district wherein the property so benefited is situate, and said assessors shall place the amount to be paid yearly on the assessment-roll opposite the property benefited and under the head of "property benefited by water storage" and such sum shall be collected in the same manner as general taxes are collected, and shall be paid to the treasurer of the county and by him paid to the state treasurer to the credit of a state water storage fund. Where the assessment so made is upon a municipality, the said commission shall file a statement of the amount so fixed by it with the chief fiscal officer of such municipality. The yearly sum so assessed by said commission against the municipality shall thereupon become a tax upon such municipality, and it shall be the duty of the officers of such municipality to raise yearly the said sum of money in the manner in which the general expenses of such municipality are raised, and pay the amount thereof yearly to the state treasurer, who shall deposit the same to the credit of the fund known as the state water storage fund, but no tax shall be assessed under this section upon the property where the owner has entered into a contract with said commission to pay yearly to the state the value of the benefits conferred by water storage during the life of such contract nor upon any municipality which has entered into a like contract during the life thereof.

§ 23. **Report to state water supply commission.**— Every person, copartnership, association or corporation, municipal or otherwise, subject to taxation for the benefits conferred by reason of the storage and control of the waters of any river, stream, lake or pond of the state as herein provided shall, within thirty days after receiving notice, make a written report to the state water supply commission containing a full description of its property, together with any information relating to the value of such benefits as may be required by said commission. The state water supply commission may, from time to time, require a further or supplemental report from any such person, copartnership, association or corporation, municipal or otherwise, containing information and data upon such matters as it may specify. Every report required by this section shall have annexed thereto the affidavit of the president, vice-president, secretary or treasurer of the association or corporation or one of the persons, or one of the members of the copartnership making the same or of the chief executive officer if it be a municipality to the effect that the statements contained therein are true. Said commission may prepare blanks to be used in making the reports required by this section. Every person, copartnership, association or corporation, municipal or otherwise, failing to make the report required by this section, or failing to make any special report required by the state water supply commission within a reasonable time specified by it, shall forfeit to the people of the state the sum of one hundred dollars for every such failure and the additional sum of ten dollars for each day that such failure continues.

§ 24. **Hearing on asssessment.**— On making an assessment of the benefits conferred by water storage control and regulation as herein provided, the said commission shall immediately give notice in writing to each person, copartnership, association or corporation, municipal or otherwise, affected, stating in substance that such assessment has been made and the amount thereof, and that the commission will meet at its office in the city of Albany on a day specified in such notice which must not be less than twenty nor more than thirty days from the date of the notice, to hear and determine any complaint concerning such assessment. Such notice must be served at least ten days before the hearing; and it may be served on a copartnership, association or corporation, by mailing a copy thereof to it at its principal office or place of business; and on a person either personally or by mailing it to him at his place of business or last known place of residence; on a municipal corporation by mailing it to its chief executive officer. Any person, copartnership, association, or corporation, municipal or otherwise, entitled to notice under this section shall have the right to be heard and to file affidavits and other proofs in respect to the valuation of such benefits. Section thirty-six of chapter sixty of the consolidated laws known as the tax law, applies in so far as practicable to the hearing by such commission under this section.

§ 25. **Certiorari to review assessment.**— An assessment of benefits as aforesaid by the said commission may be reviewed in the manner prescribed by article thirteen of chapter sixty of the consolidated laws, known as the tax law, and that article applies as far as practicable to such an assessment, in the same manner and with the same force and effect as if the assessment had been made by local assessors; a petition for a writ of certiorari to review the assessment must be presented within fifteen days after the completion and filing of the assessment-roll and the first posting of publication of notice as required by law. Such writ must run to and be answered by the said state water supply commission, and no writ of certiorari to review any assessment or special franchise shall run to any other member or officer unless otherwise directed by the court or judge granting the writ. An adjudication made in the proceeding instituted by such writ of certiorari shall be binding upon the local assessors and any ministerial officers who perform any duty in the collection of said assessment in the same manner as though said local assessors or officers had been parties to the proceedings. The state water supply commission on filing with the city, town or village clerk a statement of the valuation of such benefits shall give to the person, copartnership, association or corporation, municipal or otherwise, affected written notice that such statement has been filed, and such notice may be served on the copartnership, association or corporation, municipal or otherwise, by mailing a copy thereof to it at its principal office or place of business and on a person, either personally or by mailing it to him at his place of business or last known place of residence.

§ 26. **State water supply commission to appear by counsel.**— In any proceeding for the review of an assessment of benefits as aforesaid made by the state water supply commission, said commission is authorized to appear by counsel to be designated by the attorney-general. The compensation of such counsel and the necessary and proper expenses and disbursements, including all expenses of procuring evidence of experts, incurred or made by him in the defense of such proceedings, and upon any appeals therein, shall, when audited and allowed as are other charges against such tax districts, be a charge upon the tax district upon whose roll appears the assessment sought to be reviewed. Where, in one proceeding, there is reviewed the assessment of benefits to more than one tax district, separate accounts shall be rendered of such costs, expenses and disbursements to the proper officers of each of said districts and audited and allowed by him as aforesaid.

§ 27. **Tax not to affect other taxes.**— The imposition of payment of a tax as provided in this act shall not relieve any person, association, copartnership or corporation, municipal or otherwise, from the payment of any other tax.

§ 28. **State water storage fund.**— All moneys received under the provisions of this act shall be paid into the state treasury to the credit of the fund to be known as the state water storage fund.

The sums so paid into the state treasury shall when appropriations have been made therefor be used:

First. For paying the cost of maintaining and operating the reservoir from which said money was received.

Second. For addition to the sinking fund to retire said bonds at maturity.

Third. For building other reservoirs or in making investigations in anticipation thereof, and

Fourth. For deposit to the general credit of the state.

§ 29. **Employees.**— The commission is authorized to employ such engineers, experts, inspectors or other employees as may in its opinion be required in carrying out the provisions of this act.

§ 30. **Bond issue.**— There shall be issued in the manner and at the time hereinafter specified, bonds of the state in amount not to exceed twenty million dollars, which bonds shall be sold by the state, and the proceeds thereof paid into the state treasury and so much thereof as shall be necessary shall be used for the construction of reservoirs, as in this chapter provided. Such bonds, when issued, shall be exempt from taxation.

§ 31. **Bonds, sale of; tax, assessment and collection of.**— Whenever the governor shall direct the commission to build a reservoir as herein provided, he shall file a duplicate copy of such direction with the comptroller, and it shall be the duty of the comptroller to cause to be prepared the bonds of this state to an amount necessary to complete such reservoir but in no event to exceed twenty million dollars; such bonds to bear interest at a rate not exceeding three and one-half per cent. per annum, which interest shall be payable semi-annually in the city of New York, at the office of some bank or trust company to be designated by the comptroller and named therein. Such bonds shall be issued for a term of not more than fifty years from their respective dates of issue, and shall not be sold for less than par. The comptroller is hereby charged with the duty of selling said bonds to the highest bidder after advertising for a period of twenty consecutive days, Sundays excepted, in at least two daily newspapers printed in the city of New York, and one in the city of Albany. Such advertisement shall contain a provision to the effect that the comptroller, in his discretion, may reject any or all bids received in pursuance of such advertisement, and in the event of such rejection, the comptroller is authorized to readvertise for bids, in the manner above provided, as many times as in his judgment may be necessary to effect a satisfactory sale. Not more than two million dollars in amount of such bonds shall be sold during the year following the date on which this chapter takes effect and thereafter such bonds shall be sold in lots not exceeding one million dollars at a time, as the same may be required for the purpose of making partial or final payments on work contracted for in accordance with the provisions of this act, and for other payments lawfully to be made under the provisions hereof. There is hereby imposed for each year after this act takes effect, and until all the bonds issued under the authority of this act shall be due an annual tax of twelve one-thousandths of a mill upon each dollar of valuation of the real and personal property in this state subject to taxation, for each and every one million dollars or part thereof in par value of such bonds, issued and outstanding in any of said fiscal years, the annual amount of such tax to be computed by the comptroller, which taxes shall be assessed, levied and collected by the annual assessment and collection of taxes in each of such years in the manner prescribed by law and shall be paid by the several county treasurers into the treasury of the state, and the proceeds of such tax, after paying the interest due upon the outstanding bonds, shall be invested by the comptroller, and, together with the interest arising therefrom, shall be devoted to the sinking fund which is hereby created, payment from which shall only be made to the extinguishment of the indebtedness created by the sale of the aforesaid bonds as the said bonds become due and for no other purpose whatever. Whenever the sinking fund herein created becomes equal to the amount of the outstanding bonds, no further direct tax shall be levied on account of said sinking fund, and said tax shall be reduced to an amount equal to the accruing interest.

§ 32. **Chapter to be submitted to vote.**— This law shall not take effect until it shall have been submitted to the people at a general election and have received a majority of all the votes cast for and against it at such election; and the same shall be submitted to the people of this state at the general election to be held in November, nineteen hundred and ten. The ballots to be furnished for the use of voters upon the submission of this law shall be in the form prescribed by the election law and the proposition or question to be submitted shall be printed thereon in substantially the following form, namely: "Shall chapter (here insert the number of this chapter) of the laws of nineteen hundred and ten, entitled 'An act to provide for the general and systematic conservation development and regulation of the water resources of the state for the use and benefit of the people of the state; defining procedure and prescribing penalties; providing for issuing bonds to an amount not exceeding twenty million dollars and for a submission of the same to the people to be voted upon at the general election to be held in the year nineteen hundred and ten,' be approved."

§ 33. This act shall take effect immediately.

PART II.

REPORTS OF ENGINEERS.

I. **WALTER McCULLOH**, Consulting Engineer.
II. **JULIAN THORNLEY**, Resident Engineer.
III. **ALBERT H. PERKINS**, Resident Engineer.
IV. **ERWIN E. HASLAM**, Resident Engineer.
V. **CHARLES T. RHODES**, Resident Engineer.

I.

REPORT OF WALTER McCULLOH, CONSULTING ENGINEER.

ALBANY, N. Y., *January* 15, 1910.

To the State Water Supply Commission, Albany, N. Y.:

GENTLEMEN.— My report for the year ending December 31, 1909, is respectfully submitted hereunder:

WATER SUPPLY.

Nineteen applications for the right to construct water works or to obtain a new source of water supply have been presented to your Commission during the year, by cities, villages, water districts or private water companies. These applications have been referred to your engineer for investigation and reports upon their engineering features have been submitted in each case at the time it was under consideration. Most of these cases involved simple water supply engineering features and are worthy of no special mention.

Three applications, however, involved questions of especial interest. The first of these is No. 48 from the village of White Plains, presented on December 30, 1908, but is herein considered with the applications of 1909. The engineering question in this case relates to the effect which would result from allowing a municipality to appropriate to its use a portion of a certain watershed from which other municipalities are drawing their supply. A further important question is present, the advisability of establishing in the near future, a metropolitan system of water works to supply all of the municipalities adjacent to New York city on the north.

The second case is application No. 55 by the city of Niagara Falls. This is an example of a condition which would seem to justify some State authority such as your Commission, in taking steps to relieve a water supply situation which has become intolerable to the community. The right to furnish water for domestic purposes in the city of Niagara Falls was divided between a municipal water works and a private water company, both companies taking their water supply from the Niagara river and delivering it in its raw state to the consumers. Although it had been known for a number of years that the water in its raw state was absolutely unsafe for domestic purposes because of the contamination from the sewage of the city of Buffalo and the towns of Tonawanda, North Tonawanda and LaSalle, yet its use continued. The use of this water caused a scourge of typhoid fever almost continuously, which placed the city of Niagara Falls in an unenviable position due to the high death rate from typhoid fever. The city had repeatedly endeavored but with little success, to come to some agreement with the private water company whereby it might acquire the water works plant and consolidate it with the municipal plant and introduce a system of purification so that the whole city might be furnished with pure and wholesome water. An amendment to the city charter was passed by the Legislature of 1908 creating a board of water commissioners with power to construct a new water works to be owned and controlled by the municipality. The board of water commissioners was promptly organized after the enactment of the law creating it, and an application to the Water Supply Commission followed in due time. Immediately upon the granting of the application by your Commission, the work of constructing a new water works, including a filter plant, was undertaken at an estimated cost of $717,000. A large amount of work has been done on this plant in accordance with the plans submitted with the application.

The third case of interest is application No. 57 by the village of Canajoharie, which also involves a question between a private water company and a municipal plant. The water supplied at Canajoharie by a private water company having proved inadequate and otherwise unsatisfactory, the village thereupon decided to seek a new source of supply and construct a municipal plant. The application was therefore made to the Commissioners for the right to go to a system of springs situated in the hills to the north of the village, a distance of 12 miles, where an adequate supply of very pure and wholesome water could be obtained. This application has been strongly opposed by the private water company from legal and engineering standpoints and at this date the case is still pending.

In addition to studying and reporting upon the new applications presented to the Commission during the past year a study was undertaken by your engineer, of all water supplies in the State which were included in your first and second reports together with such other water works as have been introduced since the date of those reports. It was found impracticable to carry these studies out as contemplated without having available engineers or inspectors to visit the communities and make a personal inspection and collect the necessary data. The collection of such data by correspondence proved to be unsatisfactory and absolutely unreliable owing to the fact that many of the water works were dilatory in sending the replies or would not take the trouble to answer the questions properly and carefully. This method of collecting data was abandoned and a study was made of all of the replies to inquiries received from the inquiry blanks sent out to cities, villages, towns and private water companies by your Commission in 1905 and 1906. These have been tabulated and reclassified with respect to the source of supply, the purity of the source, the purification or filtration of the supply and the disposal of the sewage of the communities with respect to the rights of others, especially as to their water supply.

In studying the matter of sewage disposal we found that the same subject has been pursued in great detail by the State Department of Health and that there is in that department a most complete compilation of data showing the disposal of sewage and wastes of all of the principal cities and villages and many of the towns in the State. It was, therefore, thought unwise for your engineers to attempt to duplicate the work and especially so as it was found that the necessary information could not be acquired promptly and accurately by correspondence. At a conference between the Department of Health and your engineer it was suggested by the engineer of the Health Department that an agreement be made between that department and the State Water Supply Commission for the interchange of data relating to water supply, sewage disposal and the purity of the streams of the State and also that an understanding be had between the departments so that where there is an apparent conflict or overlapping of the duties of each these matters might be adjusted so as to save time and expense to both departments. Your engineer believes that if such an agreement could be made it would result in a saving of time and expense and would prove of benefit to your Commission when considering the applications from towns or cities located upon any of the principal streams of the State.

Statistics have been secured in regard to the execution of the plans under each of the applications made to your Commission since its organization and we find that with one or two exceptions the plan proposed by the applicant was carried out promptly upon the granting of the application and in accordance with the plans and specifications filed therewith. The following table shows briefly the result of the investigation, showing the name of the town, the number of the application, and the cost of the new work completed or the amount of money expended to date.

Table of Water Supply Applications to December 31, 1909.

APPLICANT.	APPLICATION.			Source of supply.	Gravity or pump.	Work completed.	Cost of work done.	CONSUMPTION.	
	No.	Presented.	Granted.					Per day.	Per capita.
								Gallons.	*Gallons.*
Bainbridge	35	Feb. 20, 1908	Withdrawn	...	...	...	...	...	...
Bainbridge	51	Mar. 16, 1909	Aug. 18, 1909	Yaleville brook	Gravity	Oct. 1909	$7,000	150,000	80
Bergen	13	Oct. 18, 1906	Nov. 8, 1906	Wells	Pump	Nov., 1907	22,000	6,816	12
Brewster	12	Oct. 12, 1906	Feb. 20, 1907	Springs	Both	Aug., 1908	47,000	25,000	50
Briar Cliff Manor	37	April 18, 1908	Withdrawn	...	...	...	...	...	...
Canajoharie	57	June 1, 1909	Pending	Springs	Gravity	...	...	...	...
Carthage	15	Dec. 13, 1906	Mar. 14, 1907	Springs	Gravity	Nov., 1908	181,368	X	X
Central Bridge Water Co	60	July 2, 1909	July 29, 1909	Scott brook	Gravity	Oct., 1909	2,900	X	X
Clifton Springs	45	Oct. 5, 1908	Oct. 14, 1908	Springs	Gravity	None	...	...	...
Constableville	5	Dec. 30, 1905	April 19, 1906	Springs	Gravity	Dec. 1906	19,000	X	X
Croghan	58	June 17, 1909	Sept. 22, 1909	Springs	Gravity	In progress	...	...	...
Edmeston Water Co	42	Aug. 14, 1908	Sept. 16, 1908	Springs	Gravity	Oct. 1908	5,841	50,000	100
East Aurora	25	June 13, 1907	July 18, 1907	Wells	Pump	Oct. 1907	6,600	X	X
East Syracuse	41	June 30, 1908	Aug. 14, 1908	Springs	Gravity	None	...	...	...
Farmingdale	66	Sept. 22, 1809	Discontinued.	...	...	...	...	...	...
Fultonville Water Co	52	Mar. 17, 1909	Pending	Sprite creek	Gravity	...	...	...	...
Glens Falls	49	Mar. 6, 1909	April 21, 1909	Butler brook	Gravity	Dec. 1909	79,000	1,500,000	100
Gloversville	14	Nov. 27, 1906	Jan. 18, 1907	Spring brook	Gravity	Sept. 1909	33,000	2,500,000	100
Gloversville	32	Jan. 16, 1908	Feb. 18, 1908	Port creek	Gravity				
Great South Bay Water Co	31	Dec. 14, 1907	Jan. 21, 1908	Wells	Gravity	Oct. 1908	50,000	700,000	140
Hannacroix Water Co	16	Dec. 22, 1906	Oct. 17, 1907	Springs	Gravity	Dec. 1909	7,000	X	X
Harmon Water Co	39	July 16, 1908	Withdrawn	...	...	...	...	...	...
Holland Patent	11	Aug. 25, 1906	Sept. 25, 1907	Spring brook	Gravity	June 1909	30,000	50,000	100
Kingston	2	Oct. 27, 1905	Withdrawn	...	...	...	...	...	...
Livonia	63	July 20, 1909	Oct. 21, 1909	Springs & wells	Pump	In progress	...	...	...
Lockport	9	May 24, 1906	July 13, 1906	Niagara river	Pump	Jan. 1910	600,000	5,000,000	250
Lyons Falls	4	Dec. 26, 1905	Mar. 28, 1906	Spring	Gravity	Nov. 1906	28,604	5,000	10
Malone	10	June 28, 1906	Jan. 18, 1907	Springs	Gravity	None	...	...	...
Malone	34	Feb. 12, 1908	Withdrawn	...	...	...	...	...	...
Marcellus	43	Aug. 24, 1908	Sept. 30, 1908	Springs	Gravity	Sept. 1909	33,000	X	X
Martinsburg water district	26	July 2, 1907	July 15, 1907	Springs	Both	Oct. 1908	11,000	X	X
McGrawville	33	Jan. 20, 1908	Mar. 11, 1908	Wells	Pump	Sept. 1908	21,000	X	X
Mechanicville	59	June 22, 1909	July 20, 1909	Plum brook	Pump	Nov., 1909	12,725	750,000	38
Millbrook	7	Feb. 21, 1906	Withdrawn	...	...	...	...	...	...
Mount Morris	64	Aug. 2, 1909	Pending	Wells	...	...	...	...	...
New York City	1	Nov. 3, 1905	May 14, 1906	Esopus creek	Gravity	In progress	18,625,000	...	...
New York City, Catskill aqueduct	27	July 12, 1907	Oct. 15, 1907	Esopus creek					

NOTE—X indicates "No record kept."

Table of Water Supply Applications to December 31, 1909 — (Concluded).

APPLICANT.	APPLICATION.			Source of Supply.	Gravity or pump.	Work completed.	Cost of work done.	CONSUMPTION.	
	No.	Presented.	Granted.					Per day.	Per capita.
New York City, Schoharie watershed	28	July 12, 1907	Discontinued.						
New York City, Suffolk county sources	40	July 29, 1908	Pending	Wells					
New York City, Nassau county supply	50	Mar. 12, 1909	May 15, 1909	Wells	Pump	In progress	1,625,000		
Niagara Falls	55	April 20, 1909	June 25, 1909	Niagara river	Pump	In progress	200,000		
Old Forge	21	Mar. 13, 1907	April 5, 1907	Springs	Gravity	Nov., 1907	18,000	X	X
Oneida	3	Dec. 2, 1905	Mar. 16, 1906	Springs	Gravity	Dec., 1906	54,000	X	X
Ossining	22	Mar. 13, 1907	Nov. 26, 1907	Croton river	Gravity	In courts			
Painted Post	65	Aug. 18, 1909	Sept. 3, 1909	Wells	Pump	In progress	10,000		
Palenville water district	38	April 27, 1908	Withdrawn						
Peekskill	23	May 15, 1907	Discontinued.						
Petersburg water district	62	July 15, 1909	Oct. 14, 1909	Fly creek	Gravity	In progress			
Plattsburg	17	Jan. 19, 1907	Feb. 27, 1907	Brooks	Gravity	None			
Pleasantville	18	Feb. 9, 1907	Aug. 6, 1907	Brooks	Both	June, 1908	23,500	65,000	40
Rensselaer	54	April 12, 1909	April 23, 1909	Hudson river	Pump	Nov., 1909	20,000	1,800,000	100
Rome	29	July 20, 1907	Aug. 15, 1907	Fish creek	Gravity	Jan. 1, 1910	450,000	4,000,000	192
Seneca Falls	19	Feb. 21, 1907	Oct. 16, 1907	Cayuga lake	Pump	In courts			
Shortsville	44	Oct. 5, 1908	June 15, 1909	Spring	Pump	July, 1909	29,996	X	X
Staatsburg Water Co	36	Mar. 6, 1908	April 10, 1908	Stream	Gravity	Feb., 1909	57,000	X	X
Syracuse Suburban Water Co	47	Dec. 1, 1908	April 9, 1909	Otisco lake	Gravity	In progress			
Tannersville Water Co	30	Aug. 23, 1907	Dec. 21, 1907	Schoharie kill	Pump	Aug., 1907	20,000	X	X
Urban Water Supply Co. of Mineola, L. I	24	May 22, 1907	July 16, 1907	Wells	Pump	None			
Waterville	20	Mar. 6, 1907	May 9, 1907	Brook	Gravity	Oct., 1908	30,000	X	X
Watervliet	6	Jan. 25, 1906	Withdrawn						
Webster	46	Nov. 23, 1908	Dec. 14, 1908	Spring	Both	Nov., 1909	32,000	X	X
Webster	56	May 5, 1909	June 15, 1909	Spring	Both				
West Carthage	53	April 7, 1909	April 22, 1909	Vrooman spring	Gravity	Dec., 1909	30,000	256,000	160
White Plains	8	April 20, 1906	June 15, 1906	Wells	Pump	Sept., 1907	208,894	1,281,000	71
White Plains	48	Dec. 30, 1908	Nov. 30, 1909	Mamaroneck river	Pump	None			
Whitney's Point Water Co	61	July 8, 1909	July 30, 1909	Springs	Gravity	Nov., 1909	2,477	175,000	150

NOTE.—X indicates "No record kept."

Application No. 1 by the city of New York is by far the one of greatest importance in the State. Upon this project estimated to cost $161,000,000 a vast amount of work has been done. Contracts to the amount of $64,225,000 have been awarded by the Board of Water Supply covering the Olive Bridge dam and Ashokan reservoir and an aqueduct from the dam on Esopus creek in the Catskills to the Hill View reservoir site at the north line of the city of New York. Three reservoirs and 83 miles of tunnel are now under contract for construction. A total of $18,625,000 has been expended on this work to December 31, 1909. In addition to the work under contract, very extensive engineering surveys and studies have been made by the Board of Water Supply for the extension of the water supply distributing system in the several boroughs comprising Greater New York, and a new application has just been filed for the right to construct a distributing tunnel under Manhattan Island and the East River into the Borough of Brooklyn with pipe extensions to cover a distributing system in Brooklyn and under the Narrows to the Borough of Richmond.

Application No. 55. The City of Niagara Falls has awarded contracts for a pumping station, intake pipes, distributing mains and pumping machinery to the amount of $360,000. About 50% of the work has been completed up to December 31, 1909.

Three instances were found where the applicant has done absolutely no work under the proposed plans since the application was granted. The Urban Water Supply Company of Mineola, Application No. 24, granted on July 16, 1907, has never attempted to build the proposed water works for the village of Mineola. We find, however, that instead of the water works being built by the Urban Water Supply Company, the village of Mineola built a water works on its own account and without making application to your Commission.

Construction work aggregating approximately $23,000,000 has been done under the water supply applications granted by the State Water Supply Commission since January 1, 1906.

RIVER IMPROVEMENT AND WATER POWER INVESTIGATIONS.

My report for the year 1908 brought the record of engineering operations in connection with river improvement work and water power investigations, up to February 1, 1909. At that time all field work except the Genesee River survey had been finished for the season and the office work upon studies, maps and estimates had been closed up so far as they were required for your fou annual report. Rainfall stations which had been maintained since September, 1907, were being continued, also certain stream gaging stations were being maintained in co-operation with the U. S. Geological Survey and a plan had been prepared for the establishment of new stream gaging stations at points on important rivers where reliable information was lacking.

There remained to be completed, at the date of my last report, certain detailed surveys in order to finish the studies on the Schroon, Hudson, Sacandaga and Raquette rivers. There also remained to be made surveys to accurately locate all of the State land which might be involved in each one of the many proposed reservoir sites in the Adirondack regions.

The principal work remaining for the ensuing year was the collection of data for, and the formulation of, a plan or scheme for the progressive development of the water powers of the State, with which proposition there is to be submitted to the Governor and the Legislature a draft of proposed legislation which would carry the suggested plan into effect.

ORGANIZATION.

The appropriation for water power studies in 1908 having been practically exhausted by February 1, 1909, the force of men was reduced to its lowest limits consistent with the proper care of the large amount of data and maps which had been prepared or collected in the office. This reduced force consisting of David R. Cooper, Assistant Engineer, a draughtsman and two tracers, was kept employed finishing up the maps, plans and details and preparing them for proper classification and filing. When the appropriation of 1909 became available about the middle of May, the office force was enlarged and field parties were again organized and sent to the several districts to take up the unfinished work of the previous years. Some little difficulty was experienced in getting a sufficient number of men at short notice to take the field but by July 1st the parties were practically complete.

On February 28, 1909, a civil service examination was held for the grade of resident engineers in this department so that an eligible list might be established from which regular appointments could be made. The examination also served the purpose of testing the qualifications of the four engineers then holding the position of resident engineer under the exception granted by the Civil Service Commission. The results of the examination were not reported to us until May 24th when we found that three of our employees stood at the head of the list and the fourth one stood seventh. They were thereupon regularly appointed resident engineers in the following order: Julian Thornley, Erwin E. Haslam, Charles T. Rhodes, William R. Neely. Mr. Neely having accepted a position with the Board of Water Supply in New York City resigned on June 1st and in his place Albert H. Perkins was duly appointed from the list. To Julian Thornley was assigned the reconnaissance of the rivers in the northwestern portion of the State in the watersheds of Lake Ontario and the St. Lawrence river. Mr. Perkins, who succeeded Mr. Neely, took charge of surveys in the Hudson river watershed, and was later assigned to the reconnaissance of the Lake Champlain drainage area. Mr. Haslam was returned to the Raquette river territory with headquarters at Tupper Lake, where he had been the previous year, and Mr. Rhodes remained in charge of the Genesee River surveys. David R. Cooper, Assistant Engineer, was put in charge of work in the headquarters office, supervising drafting, hydrographic studies and the collection and compilation of data.

The surveys have been devoted to the Hudson, Raquette and Genesee river watersheds, special attention being given to the Schroon lake and Sacandaga river in the Hudson watershed, to Long Lake, Round Lake and Little Tupper Lake in the Raquette river watershed, the lower Genesee and the Canaseraga valleys in the Genesee watershed, the latter work being done in connection with the river improvement investigations.

All of the field work was substantially completed by November 1, 1909, and the survey parties reduced as rapidly as practicable and consistent with prompt completion of the office and mapping work. Many of the men returned to college in October and others were transferred to either the State Engineer's department or the Department of Highways.

The total number of engineering employees at any one time during the year was seventy-five (75), all of whom were duly appointed from certified Civil Service lists.

RIVER IMPROVEMENT.

Genesee River.—Under the direction of Resident Engineer Charles T. Rhodes, the surveys in the Genesee valley between Mount Morris and Rochester were continued through the winter and spring months without interruption. A complete survey was made of the territory lying between the Erie Railroad on the east and the Pennsylvania Railroad on the west, extending from Mount Morris to the southerly line of the city of Rochester, also along the Honeoye creek in the town of Rush and along the Red and Black creeks near Rochester. Within these limits lies the territory subject to flood outside of Rochester. The flooded portion in the city has not been surveyed. The survey was made to include the entire area which is subject to flood damage during high water periods on the Genesee river and covered about 30,000 acres. Maps and tracings have been made of the entire territory in convenient form for filing. The maps have been made in such detail as will show the contours, the areas flooded in the highest floods of record, the boundary lines of counties, towns and villages, also the boundary lines of the several farms, the names of owners of the property and the present character of the land, whether arable, pasture, swamp or woodland. All railroads, highways, water courses and buildings are also shown. The original maps were plotted in the field office, then sent to Albany, where they have been verified and reduced in scale to proper standard size sheets and traced.

Genesee Floods.— Careful observations have been made during the year on the action of the Genesee river during the low water periods of the winter and summer and high water stages in the spring time. Two large floods occurred, the first in February and the second on the last day of April and first of May. The latter flood was in point of volume and flooding effects one of the largest of recent years. These two periods of high water afforded excellent opportunities to study the effect of the floods in the entire Genesee valley. Records were taken at the St. Helena gaging

station below the Portage Falls, at Mount Morris, Jones' Bridge, Geneseo, Avon and Elmwood avenue in the city of Rochester. At some of the points hourly records were kept on the rise and recession of the water. The data obtained has been of great value in the study of the Genesee river problems. The effect of the Genesee floods upon the valley of the Canaseraga creek was also observed and recorded.

The floods rise rapidly at Mount Morris coming through the steep gorge from Portage with a rush and then spread out upon the flat lands in the lower valley when the waters reach the level country where the river channel is very crooked or narrow. There are two or three places in the river where the banks are high and the channel narrow obstructing the flow of the river causing it to back up and spread out over the low lands between the river and the steep sides of the valley. In some places we find the water reaches a depth of 6 or 8 feet over the farm land, but in general it is 2 to 3 feet deep. It spreads out over a very wide area, at some places at least two miles wide and covered in all about 25,000 acres in the May flood of 1909.

A study of the flood records indicates that a discharge of about 12,000 cubic feet per second at Mount Morris can pass through the lower river without causing any damage and with but slight overflowing of the river banks, but when the flow is greater than 12,000 cubic feet per second at Mount Morris there is usually at the same time a large volume of water discharged into the river by Canaseraga creek. The combined flow becomes too great for the river channel to carry, hence it is at such times that the flooding of the lands occur.

During the flood of February 28, 1909, the peak discharges at Mount Morris reached 24,000 cubic feet per second and on May 2nd, the peak was 28,000 cubic feet per second. A flood which rises in twelve hours and overflows the banks of the river between Mount Morris and Rochester generally remains on the lands for two or three days, and at some places a week or ten days elapses before the lands are free of water.

Applying the information obtained from the floods of 1909 to the studies for the Portage reservoir we are convinced that the plan proposed in our last year's report, for the construction and operation of the Portage reservoir (reserving the top six billion cubic feet capacity of the reservoir for flood control) would amply provide for any flood which may be reasonably expected in the Genesee watershed if it does not exceed the greatest floods of the past fifty years. We find that the allowance made in the calculations for flood storage at Portage is more than would actually be required to have successfully regulated and controlled the floods of 1909.

The surveys and studies show that the necessary storage for flood control can be accomplished by a smaller reservoir than the one designed for the Portage site and that such a reservoir can be constructed in the deep gorge between Mount Morris and St. Helena. The smaller reservoir with a capacity of six billion cubic feet would stop and hold the flood wave and prevent the inundation of the flats but would be of small value for the regulation of the summer flow of the river, owing to the fact that the basin must be promptly emptied after each flood in order to prepare for the control of the next succeeding one.

A map of the Genesee river valley, including the Canaseraga creek has been prepared and is submitted herewith showing the location and sizes of the proposed Portage and Mt. Morris reservoirs, the former being a combination of storage for water power and flood control while the latter is contemplated for flood control only. The map also shows the extent of the territory subject to floods between Mt. Morris and Rochester. This territory would constitute the Genesee River Improvement District in addition to the Canaseraga Improvement District, which has already been established. See plate 5, page 144.

Hydrographs of the 1909 flood appear on Plate 4 opposite page 140, and illustrate the action of the flood at Portage, Mt. Morris, Jones' Bridge and Rochester. From these diagrams it will be seen that the flood at Portage and Mt. Morris rises rapidly to a sharp peak and recedes almost as rapidly. At Jones' Bridge, which is the next record point north, the peak is pronounced but not as sharp. At Rochester the peak of the flood is very much flatter and the time required for the flood to pass is much longer than at Mt. Morris, showing the storage effect of the flood spreading itself over the valley. On the same plate is shown a hydrograph of the effect which a storage reservoir for flood control would have had on the 1909 flood provided it was empty at the beginning of the flood. A study of these hydrographs very clearly demonstrates that the storage reservoir would have controlled the flood so that instead of its rising to a sharp peak and passing down the valley in the form of a flood wave of a day or two, the wave would have been stopped and the flood waters allowed to pass off in two weeks or more instead of two or three days. In this case the river would not have overflowed its banks.

For the purpose of comparing the practicability of the two proposed reservoirs, estimates have been prepared upon both propositions. The Portage reservoir contemplates raising the dam for flood storage 19 feet higher than would be required were the dam built for power storage alone. This added height would provide a storage basin 15 feet in depth from the crest of the spillway to the flowage level provided for the power storage, having the same storage capacity as the Mt. Morris reservoir. The estimated cost of this additional storage, including the cost of raising the dam, the purchase of the necessary land and a due proportion of the cost of changing the Pennsylvania Railroad is $550,000. The annual fixed charges on this portion of the Portage reservoir would be about $31,600, which includes interest on the bonds at 3 per cent. and a sinking fund charge on a 35 year 3 per cent. basis.

The estimated cost of the Mt. Morris reservoir, including the dam, land damages, change of highways, etc., is $1,200,000, and the annual fixed charges on the same basis as above are estimated at $71,000.

The above statements clearly demonstrate the economy of the combined reservoirs at Portage, provided the power reservoir is to be built, but if the power storage proposition is not to be put into effect then it would be more practicable to build the dam at Mt. Morris than to endeavor to secure the same amount of control by a dam at Portage. The Mt. Morris scheme does not involve the change of railroad or the flooding of villages and valuable farm land as does the Portage scheme.

Canaseraga Creek.— Upon the completion of the surveys on the Genesee river, about the middle of July, the matter of the determination of a definite improvement district for the Canaseraga creek was taken up and the Genesee survey parties transferred to that work.

A complete resurvey has been made of the flooded district in the Canaseraga valley from Mount Morris to Dansville. This survey has been mapped and shows the territory with the same completeness as that mentioned above in connection with the Genesee river survey. At a conference held at Geneseo on June 28, 1909, between the property owners' committee and Commissioner Acker, Attorney Lockwood R. Doty and your engineers, it was determined that the improvement district should be based upon the flood of 1902 which was one of the most disastrous floods on record in that valley, second only in the matter of height of water to that of the great flood of 1865. After the decision to base the limits of the improvement district upon the flood of 1902, surveys were pushed forward to locate from all obtainable reliable data, the level to which the water raised in 1902. Many authentic high water marks were found, established at the time of flood, on the sides of buildings or upon trees. Information was also obtained from the railroad companies showing the points between which their railroad tracks were covered with water. A very reliable flood profile was established from the junction of the Canaseraga creek with the Genesee river, up to the Cumminsville bridge near Dansville from which a high water flow line was run round the basin establishing on the ground the boundary of the proposed improvement district. This survey of the flood flow line, has been plotted upon the maps and a complete description thereof by courses and distances has been made both of which are now ready for submission to the interested property owners.

In addition to locating the limits of the improvement district the surveys were made so as to locate the boundary lines of the several separate farms or other parcels of land within the district. The character of the land in each separate parcel was also noted and is shown on the maps.

In establishing the ownership of the lands, Mr. Rhodes, in cooperation with Mr. Doty, the attorney, made searches in the

county clerk's office and by other methods of inquiry sought to determine, beyond question, the legal owner of each parcel within the district. The area of each farm or other parcel has been calculated and listed by towns. The total area in the drainage improvement district is about 11,000 acres.

Raquette River.— On July 19, 1909, the village of Tupper Lake presented an application to this Commission under Chapter 284 of the Laws of 1909, for the construction of a dam in Raquette river at what is known as the Setting Pole Rapids, where there now stands a timber dam built by the State in 1869. The object of the proposed new structure is the protection of the public health and safety by the control of the high and low water levels in Raquette pond near the village of Tupper Lake so that in the summer season the water may be held at such an elevation that the mud flats and swamp lands will not be uncovered, and that boating on the lake may be made more safe by providing a greater depth of water over the existing submerged stumps than is now possible. It is also hoped by this proposed improvement to so control the flood waters as to eliminate the flooding of certain portions of the village adjoining the lake shore and especially the section near the railroad known as the " the Junction." The latter territory is usually more or less flooded every spring.

In order to determine the advisability or the necessity for the State to take up this proposed work, Resident Engineer E. E. Haslam and a party were promptly sent from Tupper Lake to make a survey of the proposed dam site in anticipation of a similar survey and set of plans to be made by the village engineer and submitted by the village trustees. It developed that the two surveys were made conjointly and in due time plans were submitted for a proposed concrete dam with flood gates, one plan being prepared by the village engineer and one by our Mr. Haslam. A hearing on the application of the village trustees was duly held at Tupper Lake on September 2d, at which evidence was presented showing the necessity for the proposed improvement and the method to be followed by the village in raising the necessary funds as required by the act. In addition to the work done by our engineers at Tupper Lake the plans for the proposed dam have been fully studied and somewhat revised at the headquarters office and are now practically completed awaiting the further action of the village in raising sufficient money to provide for the construction of the dam.

SURVEYS AND INVESTIGATIONS, EASTERN DIVISION.

Schroon River.—As early in the year as weather conditions would permit, and funds were available, William R. Neely, Resident Engineer, and a party was sent to Schroon Lake to take up the work left unfinished at the close of the previous season, especially to complete topographical surveys on the east and north shores of Schroon Lake, and to locate by survey all the State land involved. Mr. Neely was succeeded by A. H. Perkins on June 1st and the latter continued the work during the balance of the year finishing, so far as time and funds would permit, the uncompleted surveys, including Paradox Lake, the north end of Schroon Lake and the territory extending up the Schroon river for about four miles from the lake. Also a more complete study was made of the territory at Tumblehead Falls, the site of the proposed dam. Upon the completion of this work special surveys were made to locate all the State lands included in the proposed Schroon Lake storage reservoir and also the State lands in the smaller reservoirs which have been heretofore proposed, namely, Chilson Lake, Blue Ridge and Schroon Falls reservoirs.

Drill boring on the dam site at Tumblehead Falls on Schroon river was started early in August by W. G. Stearns, drilling contractor, to determine the character of the subsoil strata and the underlying rock. Great difficulty was experienced by the drillers in sinking the holes owing to a large deposit of hard boulders and and sand under the surface of the ground. Two very satisfactory holes were eventually drilled resulting in the location of rock at a depth of 38 feet, much nearer the surface than we expected to find it. The effect of this will probably be a material reduction in the cost of constructing the proposed Tumblehead dam, although more drilling will be necessary to locate bed rock in the center of the stream. Surface indications are that it is not much below the river bottom.

Sacandaga River.— The parties were transferred to the Sacandaga river upon the completion of the Schroon surveys and stationed at Northville, from which point the unfinished surveys for the proposed Conklingville (Sacandaga) reservoir were completed, including the territory extending up the Sacandaga river for about four miles above Northville. Surveys were also made at Lake Pleasant, Sacandaga Lake, Piseco Lake and the Arietta Flow for the purpose of locating and determining the area of the State lands lying within these proposed reservoirs. All of these surveys have been plotted and are being reduced to standard size maps and estimates are being made upon these various propositions. The Sacandaga reservoir (dam at Conklingville) mapping is finished.

RECONNAISSANCE, EASTERN DIVISION.

Upon the completion of the surveys by Mr. Perkins and his party, the force was reduced to only the necessary men for office work while Mr. Perkins immediately started on the power and storage reconnaissance of the Champlain drainage area including the Boquette, Ausable, Saranac, Chazy and Chateaugay rivers and Lake George outlet. A full report upon the reconnaissance by Mr. Perkins will be transmitted herewith, but herein attention will be called briefly to the more important opportunities for storage and power found in the territory.

Ausable River.—The river rises in the heart of the Adirondack mountains at Lake Placid and flows northeasterly into Lake Champlain, falling 1,770 feet in about 40 miles of its course. Only about one-fifth of this fall is now utilized for water power development, the principal power plants being at Ausable Chasm, Keeseville and Ausable Forks, with a total water wheel installation of 6,140 horsepower. It is estimated from the reconnaissance that 1,365 feet of the fall in the river is possible of development, and with river regulation the total power possibilities of this fall aggregate 33,000 horsepower on the main stream and west branch and 8,000 horsepower on the east branch. The sites for possible power developments are at Keeseville, Clintonville, Rome, Wilmington, The Flume and Wilmington Notch. Two promising reservoir sites were investigated, the better one being at Cherry Patch Pond on the west branch, where with a dam storing water to a depth of 85 feet, two billion cubic feet could be stored. Above this dam is a catchment area of 118 square miles, but within the reservoir site there are approximately 262 acres of State land which would be involved in the project. The second most feasible reservoir site is at Indian Face on the east branch, where with a dam 70 feet high one billion cubic feet could be stored. No State land is involved in this basin.

Sufficient data is not at hand to make detailed estimates upon these storage projects to test their practicability, but a preliminary estimate which is doubtless ample for all possible requirements places the cost of the larger reservoir at $207,000 and the smaller one at $150,000. The discharge from these two reservoirs is capable of developing power at the dam sites to the amount of 12,000 constant horsepower at ordinary efficiency of the wheels, which with the improvement that would accrue to the already developed water powers on the lower river would make these propositions practically paying ones if the market for the power warranted their construction.

Saranac River.— The river rises in Lake Clear in the northern central part of the Adirondack Park and flows southerly through the Upper Saranac Lake, thence northeasterly through the Middle and Lower Saranac lakes and thence into Lake Champlain at Plattsburg. The fall of the river from Lake Clear to Lake Champlain is about 1,500 feet in a distance of approximately seventy-five miles. The river has two branches, the east and the west, the former being the one of most importance as a power and storage stream. The west branch has little possibility for either. On the main river and the east branch there is at present developed about 23,600 horespower when water is plenty, whereas with regulation the possibilities are about 72,300 continuous horsepower. The present power developments are at Plattsburg and vicinity, at Cadyville, Franklin Falls and Union Falls.

There are good possibilities for storage on the Saranac river on the three main lakes by building one dam near Saranac village and another at the outlet of the Upper Saranac Lake. If such dams were to be built the result would be to hold the water at a higher level than now exists in the summer time, and be a benefit so far as the scenic value of the lakes is concerned, because of the flooding of large tracts of swamp at the ends of the lakes and between them. At the present time the scenic improvement which would

SARANAC RIVER.

Swamp lands between Lake Flower and Lower Saranac lake.

There are over 4,000 acres of swamp and flowed lands covered with dead timber, all of which would be permanently submerged if the proposed Lower Saranac lake reservoir were built.

result from construction of the dam would, in our opinion, outweigh the power value of the reservoir. The present market alone does not seem to warrant the expenditure necessary to create this storage reservoir. However, if it is built there are excellent opportunities for power development at High Falls and Teft Pond. Also, the existing plants at Morrisonville, Cadyville and Saranac village could be greatly improved if full advantage were taken of the fall and increased flow of water for the creation of new power developments. No accurate estimates have been prepared on the cost of this work as sufficient data could not be obtained on the reconnaissance.

Chateaugay River.— This river rises in Franklin county in the northern part of the Adirondack Park, and flows northerly through the upper and lower Chateaugay lakes into Canada. Fifty miles of its course lies in New York State and in this distance the fall is about 1,500 feet. There are at the present time power developments on the river at Chateaugay and Brainardsville amounting to 5,500 horespower. A reservoir may be made on the two lakes by the construction of a dam at the outlet of the lower lake, but as these two lakes are summer resorts and as the market for additional power is small at the present time, the proposition has been considered impractical for immediate consideration. If at any time the market for power increases sufficiently to warrant the raising of these two lakes for storage, the locality can be depended upon to bring the matter to the attention of the State.

Boquette River.— The Boquette river rises in the easterly portion of the Adirondack Park north of the watershed of the Schroon river and flows into Lake Champlain at Willsboro. There are only small possibilities for storage on this river and the demand for the same is very meagre at the present time. The general elevation of the watershed is low compared with the surface of Lake Champlain. The matter of storage may well be left with the power users on the stream to advance it when their needs for additional water will warrant a more complete study of this stream.

Lake George Outlet.— The outlet of Lake George has been thoroughly studied and your engineers have come to the conclusion that developments now at this point are all that the conditions will warrant. The lake is so thoroughly devoted to pleasure purposes and transportation that it would be impracticable to raise its surface any higher than the present spring flood level. The controlling works at the outlet are so arranged that the industries using the power at Ticonderoga are taking the fullest advantage that is possible, of the amount of storage obtained between the flood level and the level which must be maintained for summer navigation.

SURVEYS AND INVESTIGATIONS, NORTHERN DIVISION.

Surveys.— The Northern Division comprising the watersheds which empty into the easterly end of Lake Ontario and into the St. Lawrence river, was covered by two resident engineers, Mr. Haslam having charge of the work in the Raquette river watershed, and Mr. Thornley made a reconnaissance of all of the other rivers in the division. Their reports will be submitted herewith giving all of the matter in full detail, but attention will be here called only to some of the most important points touched upon.

Raquette River.— In the report of Mr. Freeman, January 31, 1909, attention is called to the possibility of constructing a dam on the Raquette river near Piercefield as an alternative for the dam proposed near the village of Tupper Lake. As has been clearly stated in the previous reports, the only reason for considering the construction of a dam at the site chosen near the village of Tupper Lake was in order to avoid flooding a portion of the village of Tupper Lake and practically the entire village of Tupper Lake Junction together with the railroad yards at the Junction of the New York Central and the New York and Ottawa railroads. It was thought by Mr. Freeman and Mr. Ropes that the claims of the railroad and lumber mill interests and the village for damages caused by flooding would be so heavy as to make the proposition impractical.

For the purpose of studying this proposition more carefully, surveys were made at the Piercefield dam site during the past year. The site selected for study is about 300 feet above the dam of the International Paper Company at Piercefield. The sides of the valley and the bottom of the river indicate a solid rock foundation for the dam.

The estimates of cost of the structure are based upon a masonry overflow dam with earth embankments at either end, having in them a concrete core wall. The masonry dam would be about forty feet high at the maxium section and six hundred feet in length. The earth embankments would aggregate 1,800 feet in length and have a maximum height of forty feet.

A plan has been devised and estimates made on it for a change of the lines of the New York Central and the New York & Ottawa Railroads, which change would have to be made if this project were carried out. The total length of the New York Central Railroad change would be about seven and one-fourth miles and would carry the railroad about a mile and a half to the north of the present line at Tupper Lake village. The change of the New York & Ottawa Railroad contemplates uniting it with the New York Central tracks at a point where the present line crosses the proposed new line of the New York Central about two miles west of the present junction. From this point the New York & Ottawa Railroad would run over the New York Central tracks to a proposed new freight yard established about a mile and a half north of the present junction.

The existence of that part of the village of Tupper Lake known as "The Junction" depends principally upon the work in the mills and yards of three lumber companies situated on the shores of Raquette pond and also upon the work incident to the freight yards and division station of the railroads. We have been informed by officers of the village and by representatives of certain lumber companies that these mills will within the next three or four years, have disposed of all of their lumber and need no longer maintain their plants in this locality. Most of the timber land which they own above Tupper lake has been lumbered so that there now remains only a small amount of timber to be cut and marketed. If these predictions prove true the junction portion of Tupper Lake village will be more or less deserted except for the railroad interests. With a new railroad junction and freight yard established on the plateau east of Big Wolf and a mile and a half north of the present ones, where an excellent site exists, a new settlement can readily be built up at this point.

The proposed railroad change also contemplates the construction of a spur track from the new junction to the village of Tupper Lake.

All of these conditions have been taken into account in the preparation of the estimates of the cost of a reservoir with the dam built at Piercefield.

In estimating the damages to the railroads, lumber mills and real estate at "the Junction," their present fair value has been used with due allowance for the cost of condemnation proceedings and possible indirect damages.

The principal advantages of a reservoir with the dam at Piercefield are the better natural physical conditions for a dam at this point and the possibility of creating one large reservoir in the stead of the several small ones proposed elsewhere in the drainage area. The reservoir with the flow line at elevation 1570, the same as heretofore proposed for the Tupper Lake reservoir, would have a capacity of 15 billion cubic feet, but if the flow line be raised to elevation 1575 the capacity would be increased to 19.5 billion cubic feet, the estimated amount of storage required for practically complete regulation of the flow of the Raquette river below Piercefield.

The estimated cost of this reservoir complete, with flow line at elevation 1570 is $2,690,000, and the estimated cost with the flow line at elevation 1575 is $3,267,000.

From a study of the existing water power situation on the Raquette river it is evident that the power owners would not be warranted in assuming the fixed charges on the cost of the Piercefield proposition, nor are they equipped at the present time with sufficient machinery to take full advantage of a storage of 19.5 billion cubic feet. This proposition, however, requires further surveys and closer study before a final decision is reached as to the relative advantages it may have over the proposed dam at Site No. 1, described in the Progress Report of 1908.

Little Tupper Project.— The proposed reservoir at Little Tupper lake and Round lake, referred to in Mr. Ropes' report of 1908, and which seemed the most inviting proposition for immediate attention in the Raquette river watershed, has been surveyed during the past year and carefully studied. This proposed reservoir is a combination of the two lakes with a dam at the outlet of Round lake raising the water to a maximum height of 21 feet above the present water level of Little Tupper lake, and contemplates the possibility of including the Slim ponds. If the latter were included, another dam would be necessary at the outlet of Slim pond, but if this territory is not included in the reservoir, it will then be necessary to build a dike on the ridge between Little Tupper lake and the Slim ponds to prevent the water from running over into the valley of the latter.

After further surveys and investigations are made it may be found inadvisable to include the Slim ponds in the Little Tupper lake project, because the cost of the dam at the outlet over and above the cost of the necessary dike at the foot of the lake, may prove to be more than would be warranted by the added watershed or the increased storage capacity afforded by the Slim pond basin.

A preliminary topographical survey was made to locate the flow line of this reservoir for the purpose of preparing an estimate on the land damages.

The land surrounding these two lakes is all owned by one person and held as a private preserve. There is therefore no State land involved in this project.

The estimated cost of the reservoir complete, with the flow line at elevation 1735, and including the dams at Round lake outlet and the Slim pond outlet, the land damages and change of highways is $469,400, and the available storage would be about four billion cubic feet.

A plan has been studied contemplating a tunnel of about one mile in length from Forked lake to the Little Tupper lake watershed for the purpose of carrying over into the latter basin some of the excess water of the Forked lake area. By increasing the height of the dams at the outlets of Round lake and Slim pond a very much larger storage could be accomplished, but the watershed above these points would not warrant any such provision. However, if by the tunnel scheme additional water could be carried into the basin from the Forked lake territory, it would seem that the larger reservoir would be warranted. The amount of water taken from Forked lake can be returned to its natural course in the summer, through Slim pond into Long lake or through Bog river into Tupper lake.

The estimated cost of the Forked lake proposition storing 2.5 billion cubic feet is about $165,000. The total cost of the combined project of Forked lake and Little Tupper with the connecting tunnel, is $841,000, and the combined storage capacity would be 7.14 billion cubic feet. This project could only be carried out after power to flood State land is provided, as the Forked lake reservoir would involve about a thousand acres of State land, but the possibility should be taken into account when the Little Tupper reservoir is built.

A survey was also made on Long lake and a reconnaissance on Forked lake to determine their feasibility as storage reservoirs. Of these two Forked lake is the most practical at the present time omitting the State land question which affects both of them. It has a large watershed, but the storage to be accomplished without too great a damage is only about 2.5 billion cubic feet, being only a small portion of the run-off from the watershed above the outlet of the lake.

The other surveys made on the Raquette river were in connection with the State land studies and with the Settingpole rapids dam as recorded elsewhere in this report. Full details of the surveys and estimates on the projects above referred to are set forth in the report of Resident Engineer E. E. Haslam, which will be submitted herewith.

RECONNAISSANCE — NORTHERN DIVISION.

Black River.— The river rises in the southwesterly portion of the Adirondack Park in Herkimer county and flows in a general northwesterly direction into Lake Ontario near Watertown. From its rise to the lake it falls about 1700 feet in 105 miles. The principal branches of the river are the Beaver, Deer, Moose and Sugar rivers and Independence creek. The watershed above its mouth is 1930 square miles. In point of existing power developments the Black river ranks next to the Hudson, having at the present time installations for the development of 89,000 horespower. Most of the power sites on the river are now occupied and utilized, but the irregular flow of the stream makes it necessary for these plants to maintain steam auxiliary equipments to the extent of about 4000 horsepower. Even with this auxiliary the plants suffer greatly every year from lack of water.

At the present time there is a storage reservoir at Forestport built by the state for supplying the Black river and Erie canals, having a capacity of about two billion cubic feet. In order to compensate the power rights on the river for the loss of water due to canal diversion, a reservoir was built on the Beaver river at the Beaver flow. This was constructed a number of years ago by the State, and is utilized during the summer months for such relief as it is capable of furnishing to the power plants on the Black river. The reservoir is controlled by a State Commission known as Commissioners of Water Power on Black River.

Storage Possibilities.— The reconnaissance developed the possibility of a storage reservoir at Hawkinsville below the Forestport reservoir. A dam at this point would have a height of about 110 feet and would impound 3.3 billion cubic feet of water. The territory which would be flooded is uncultivated land, mostly brush and waste land. The whole of the reservoir lies outside of the Adirondack Park, but there is a parcel of 33 acres of State land included within its limits. There is a power possibility at the dam where, under 128 feet head, some 2,000 or 3,000 horespower might be developed, but in all probability the reservoir could be better utilized for the summer regulation of the stream. The regulated flow which this reservoir would produce would be 207 c. f. s. exclusive of 250 c. f. s. which must be passed through the Forestport feeder for canal purposes. The power results of this regulated flow between the reservoir and Lake Ontario would aggregate 39,000 horsepower in the driest month of the ordinary year.

On the Moose river branch of the watershed with 416 square miles above the river mouth, one storage possibility was discovered. The watershed is heavily wooded and lies within the Adirondack Park. It has a very large run-off and some natural storage in the Fulton Chain of lakes, the effect of the natural storage being to produce a more uniform average flow throughout the year. The reservoir possibility is located at The Plains on the south branch where with a dam 90 feet high and a low dike at the south end a reservoir covering 4,600 acres would have a capacity of 6.2 billion cubic feet. A large part of the reservoir site, however, is State land, of which 2,600 acres is swampy and waste. Between the dam site and Lyons Falls, a distance of 28 miles, there is a fall of 1,080 feet. Power plants now exist at McKeever and Lyons Falls. The proposed reservoir would increase the average minimum monthly flow of the stream from 208 c. f. s. to 702 c. f. s., and would not only be of benefit to the plants on the Moose river but would add correspondingly to the Black river flow and could be utilized at once without any additional hydraulic machinery at the existing plants. The developments on the two rivers would then be capable of a uniform development of about 65,000 horsepower and there would also be a possible development at sites now unutilized of 18,000 horsepower additional, making a total possible development of 83,000 horsepower.

This reservoir would also benefit the Fulton Chain of lakes which as stated above are now utilized for storage, by making unnecessary the draft on the lakes until late in the season, practically after the summer travel has ceased. The Fulton Chain of lakes is very attractive to camping parties and is visited by a large number of people during the summer months. With the reservoir at The Plains this chain of lakes might well be kept up to their high water level until at least the latter part of August and any draft made upon them thereafter would not seriously interfere with their attractiveness as a pleasure resort.

Beaver River.— The Beaver has a watershed of 322 square miles above its junction with the Black river. It rises in Lake Lila about 1714 feet above sea level, flows through the Beaver flow and is the main branch of the Black river.

The discharge from the Beaver Flow reservoir is now regulated by, and used for the benefit of, the existing power developments between Carthage and Dexter, which territory includes Watertown. By the enlargement of the present dam, raising it about 12 feet, an additional storage of 3.4 billion cubic feet could be obtained on the Beaver flow. This would be simply an enlargement of the present state reservoir, but its construction would involve about 2,800 acres of additional State land, most of which is swampy and is now flooded every spring in the high water period. The plan is capable of further enlargement if conditions would warrant, as the height of the dam can readily be increased without greatly increasing the cost. The heaviest cost in this development would be the land damages. The stream regulation which would result from the 3.4 billions storage at the Beaver flow would add 245 c. f. s. to the present minimum flow, making a total flow of 1,040 c. f. s. at Carthage. This additional flow would mean additional power possibilities of 42,500 — 7 day, 24 hour, horsepower at the present developed sites, and with the present wheel installation. The total possible development would then be 73,000, 7 day, 24 hour, horsepower as compared with the present average constant development of 31,000 horsepower. The undeveloped power sites would yield 7,000 horsepower continuously were this reservoir to be constructed.

Another reservoir site was located at Beaver Lake (Lake No. 4), where a low dam six feet in height would hold the lake at the spring high-water level, or a little above, and would do practically no damage to the surrounding land. If, however, the Beaver Flow is fully developed, this small reservoir at Beaver Lake would not be needed.

The Deer river has a drainage area of 102 square miles above its mouth. Only one reservoir site was located in this watershed. A reservoir covering 716 acres of cultivated land and with a capacity of 700,000,000 cubic feet, could be built at Copenhagen. There are two possible power sites on the stream at present undeveloped, one at the dam and the other at King's Falls. The total development of the two sites would be only about 3,000 horsepower. The water from this storage reservoir would prove of slight benefit to any of the Black river powers.

The five reservoir sites on the Black river and its tributaries, with a combined storage of 13.4 billion cubic feet, would, if constructed, increase the minimum mean monthly flow at Carthage from 794 c. f. s. to 1,776 c. f. s., being an addition of 982 c. f. s., and this increased flow would raise the dependable power output from 28,000 horsepower to 64,000 horsepower without requiring any additional installation of hydraulic machinery in the existing plants.

Although the Black river has a large water-producing drainage area, and its yield would supply a storage of 73 billion cubic feet if reservoir sites of this capacity could be found, nevertheless it is not possible or practical to store the full amount necessary for complete regulation of the river. The full development of the storage possibilities in the watershed would mean storing 58 billion cubic feet more than the capacity of the five reservoirs above mentioned. The only possible reservoir site which could accomplish this storage is located above Carthage.

The Deep Waterways Commission several years ago made a study of the Black river in connection with federal canal projects and considered the construction of long earth embankments and a masonry dam at Carthage which would flood some 74 square miles, and back up the water as far as Lyons Falls. Several railroad lines, villages, and hamlets are situated in this basin, and part of the land included in the reservoir site is farm land now under cultivation. The Deep Waterways Commission estimated the cost of such a reservoir at about $6,000,000, but the studies of this season lead us to the conclusion that it would cost at least $7,000,000. If this reservoir were built it would add 1,284 c. f. s. at Carthage and Dexter, producing 46,200, 7-day 24-hour horsepower, but the cost of the reservoir would make the added power resulting therefrom cost for water alone the uninviting figure of $150 per horsepower, which seems to us to be excessive and prove the project impractical at the present time.

No accurate estimates of cost of the reservoirs in the Black river watershed have been attempted as they could not be made within reasonable limits without further surveys and studies having been made.

The importance of the Black river as a power stream, both for the present and future possibilities, places this stream among those of the first importance for further careful study by the State.

Salmon River, Oswego County.— This river rises in the southwestern portion of Lewis county and flows southerly and westerly into Lake Ontario near Pulaski. The fall from the rise to the mouth of the stream is 1,600 feet in 45 miles, but of this amount only about 650 feet is available for power purposes. The watershed above Pulaski is 264 square miles, is partly wooded, but mostly cultivated farming land. The existing power developments on this stream are small, being only about 360 horsepower. With storage and a regulated flow the stream has power possibilities of over 20,000 horsepower.

The study of the Salmon river watershed developed one storage possibility near the village of Redfield. At this point a dam 53 feet hight would raise water to elevation 950 above sea level or 700 feet above Lake Ontario, cover 4,370 acres and provide a storage of 5.2 billions cubic feet. The dam site is just above Salmon Falls, where, from surface indications, a rock foundation exists. There is no State land involved in this storage basin. The principal power possibility which would follow the construction of the Redfield reservoir is at Salmon Falls, where a head of 405 feet might be developed with a long penstock or flume. Such a plan would develop 19,600 continuous horsepower.

A second power possibility is at Altmar, near the mouth of the river; where there is a fall of 140 feet in about three miles. If this fall were to be utilized, a development of 3,600 continuous horsepower could be accomplished.

The Redfield project was considered by the Deep Waterways Commission and their plans contemplated building a dam of somewhat larger dimensions than contemplated by your engineers, and which would store about 7.5 billion cubic feet. It is estimated that the discharge of the stored water from this reservoir would raise the ordinary minimum mean monthly flow at Salmon Falls from 75 c. f. s. to 564 c. f. s., thereby adding 489 c. f. s. This amount of stored water would assure a regulated flow of not less than 593 c. f. s. at Pulaski, equivalent to an addition of 488 c. f. s. to the ordinary mean minimum monthly flow at the present time. The added flow at the dam site means a possible power development of 19,600 continuous horsepower, and if the 140 feet fall below Pulaski were used, 3,600 continuous horsepower is possible at that point.

The most likely market for power if developed on the Salmon river would be Syracuse or Rome, both of which cities are within reasonable transmission distance, being only 30 or 40 miles away from the Salmon Falls development.

The Oswego Light and Power Company has been formed for the purpose of developing the Redfield storage and power project, but we understand that their plan contemplates the construction of a smaller reservoir than we would recommend, and also that they contemplate utilizing only 300 of the possible 405 feet head.

We find in the report of the Deep Waterways Commission an estimate of the probable cost of the Redfield reservoir which, with proper allowance for a decrease in the height of the dam between their plans and ours and a further allowance for the increased cost of construction between the present time and the date of their estimate, we estimate that the reservoir complete would cost in the neighborhood of $1,350,000. This storage would cost $260 per million cubic feet of storage, which is higher than has been found necessary for some of the Adirondack storage propositions, but is not an excessive figure when the cost per horsepower for the development on the river without a regulated flow is taken into consideration. An estimate of the cost of power development is $2,450,000, which, with the cost of the reservoir, would make the total cost of the development $3,800,000. From this storage and power scheme 19,600 continuous 7-day, 24-horse power would be generated at the turbine shaft with 80 per cent. efficiency and only 5 per cent. of the head unutilized. With a 40 per cent. load factor this amount of power becomes 49,000 saleable horsepower. These figures do not include any development below Pulaski. Before presenting any definite recommendations on this project, further surveys and studies will be necessary.

Oswegatchie River.— This river has two main branches, one rising in Cranberry Lake, in the southerly portion of St. Lawrence county, and the other in the mountains of the northern portion of Jefferson county, and flows in a general northwesterly direction in the St. Lawrence river at Ogdensburg. From Cranberry lake to the St. Lawrence river, a distance of about 100 miles, the river falls from elevation 1540 to elevation 243, a total of about 1200 feet. The watershed above Ogdensburg is 1609 square miles. The principal branches of the river are Indian river and the east and west branches of the Oswegatchie.

There are two storage possibilities on the east branch, Cranberry Lake and Newton Falls. Cranberry Lake is used for storage purposes, having been built by a commission authorized by the Legislature some years ago, and is now owned and controlled by the State. The surface of this artificial lake is 12.8 square miles. Until within the last three or four years this reservoir has been extensively used for regulating the flow of the stream, but owing to strong objections made by property owners whose camps or homes are located along the shores, the amount of draft upon the lake has been very materially reduced. In the summer of 1909 only 8 feet depletion was permitted which equalled 1.9 billion cubic feet. Formerly a depletion of 14 feet was possible, yielding 2.5 billion cubic feet. The reason for objecting to a draft of more than 8 feet is mainly that the swamps and dead timber around portions of the lake are exposed, making the shores not only unsightly but more or less dangerous to boating. When this reservoir was created the land was of little value and the territory was flooded by the building of a dam, but without any attempt being made to clear the basin of timber. The standing timber eventually died, part of it falling, but a large portion of it is still standing as dead and unsightly stumps or trunks.

By reinforcing and raising the present dam 5 feet an additional storage can be secured without interfering with the scenic beauty of Cranberry Lake, but before any additional storage is accomplished, it will be essential that the dead stumps and timber be removed and that the live timber between the present flow line and the proposed new flow line be removed. With this improvement and the new dam, a storage of 3.6 billion cubic feet would be made available and the conditions on large parts of the shore be beautified.

Lying just below Newton Falls is a large basin of nearly seven square miles, in the bottom of which is a brush-covered swamp covering fully one-half the area of the basin. By raising the dam at Newton Falls 20 feet this swamp would be flooded to an average depth of 15 feet, 10 feet of which could be drawn off and 2 billion cubic feet of water utilized for regulation in the summer months without uncovering the swamp land.

Between Newton Falls and Dodgeville, the junction of the main stream and the east branch, there is a fall of 879 feet, of which only 129 feet is now being utilized. At least 375 feet of the remaining fall is capable of development for power, provided, however, that the stream flow be regulated as contemplated by the two above-mentioned reservoirs. From Dodgeville to the St. Lawrence river on the main stream, there is a total fall of 318 feet, of which 263 feet is either now utilized or is capable of further development by the improvement of the present dams and power plants, and by making use of several undeveloped power sites.

The combined additional storage available from Cranberry Lake and Newton Falls reservoirs is about 6 billion cubic feet, which would raise the average minimum monthly flow at Ogdensburg from 628 c. f. s. to 822 c. f. s. and make possible the generation of 16,100 net 24-hour horsepower at the mills from Newton Falls to the St. Lawrence river, being an addition of about 6,400 horsepower over the present possibilities with an unregulated flow. At the undeveloped sites 16,600 continuous horsepower would be available, making a total possible development of 32,700 continuous horsepower.

On the west branch of the river only one important site is to be found. A short distance above Harrisville a dam 40 feet high, built upon rock foundation, would form a reservoir of about 3 square miles with the flow line at elevation 865. A large part of the basin is low, swampy land covered with brush and coarse grass. The possible storage in this reservoir is 1.3 billion cubic feet. A greater storage, however, might be obtained by building a higher dam, but in order to determine its feasibility surveys and further investigations would be required and stream gaging would be necessary to establish the probable yield from the watershed.

The fall in the stream from Harrisville to Dodgeville is 226 feet, but only 40 or 50 feet of this fall is favorable for power development. The greater use for the storage effected by the Harrisville reservoir would be to benefit the existing plants between Dodgeville and the St. Lawrence river. The discharge from this one reservoir would add 5,000 horsepower to the average monthly minimum output at the present plants.

There are several smaller storage basins above Harrisville, and three small power sites, but they are of minor importance and will need closer study to determine their feasibility.

The Indian river is the most important branch and joins the Oswegatchie about 7 miles above Ogdensburg. It has a watershed of 544 square miles above the junction. The only storage possibility of considerable size on the stream is on Black lake, near the confluence of the rivers. Black lake has an area of about 17 square miles and is bordered by farms and cultivated lands. By building a dam at the outlet of the lake to the elevation reached by the ordinary spring flood level a storage of 3.0 billion cubic feet would be effected. If this dam were to be built so as to raise the level 6 feet above the flood level about 6.5 billion cubic feet would be impounded.

If instead of building the dam on the Indian river at the outlet of Black lake one be built on the Oswegatchie one mile below the junction at what is known as Eelweir bridge, raising the water 6 or 8 feet above the level of Black Lake, a storage of nearly 7.2 billion cubic feet would be obtained, and part of the flood flow from the Oswegatchie could thereby be turned into the Black Lake basin. A dam for this purpose would be about 12 feet high and situated in a rock gorge, but would require flood gates to permit unusual floods to pass. The flooded area, exclusive of the lake surface, would be 1,200 acres, most of which is cultivated land. The water would flow back on the Oswegatchie and practically eliminate the 9 feet of fall at Heuvelton and destroy the power site at that point.

The only places at which this storage could be of use are in Ogdensburg, where there is a head of 9 feet, and at the Eelweir bridge for a new development under 14-foot head. Such storage would only add 560 horsepower to the minimum monthly output at Ogdensburg, and would generate 875 horsepower at the dam, making a total of 1,435 horsepower, but at the same time the reservoir would destroy 260 horsepower at Heuvelton, leaving a net gain of only about 1,200 horsepower. Such a small gain in power does not seem to warrant the expense which would be involved in the construction of so large a reservoir as the Black Lake project contemplates.

Above Black lake there are three or four small storage basis and as many power sites, but they are not of sufficient magniture to call for special mention. They are referred to in detail in the resident engineer's report. (Page 241.)

The combined results which would follow the regulation of the flow of the Oswegatchie river by the reservoirs at Cranberry Lake, Newton Falls, and Harrisville, with the combined available storage of 6.8 billion cubic feet would be 21,000 net 24-hour horsepower at the present developed power sites and 18,000 net 24-hour horsepower at the undeveloped power sites, making a grand total of 39,500 net continuous horsepower.

Grass River.— The Grass river rises in the southeasterly corner of St. Lawrence county and west of Big Tupper Lake, at about elevation 1,750 above sea level. It flows in a northwesterly direction and thence northeasterly into St. Lawrence river, near the northerly boundary of New York State. The distance from the source to the mouth is about 90 miles and the fall is 1600 feet. The drainage area at the mouth is 637 square miles. The watershed is long and narrow, similar to that of the Raquette river, and averages only 7 miles in width, with an extreme width of 20 miles.

Three storage possibilities have been investigated on this river, one at Grass river flow, the second 2 miles above Clare, and the third at DeGrasse.

The Grass river flow is on the south branch of the river, above which there is a drainage area of 37 square miles. There is at the present time an old crib dam in very bad repair at the outlet of the flow. By removing the old dam and replacing it with a concrete structure founded on rock and 10 feet higher than the old crib, or to elevation 1540, 3600 acres of worthless, half-flooded swamp land would be submerged to a depth of 20 feet and a storage of 3.5 billion cubic feet would be accomplished. This basin lies wholly within the Adirondack Park, but there is no State land involved in the project.

On the north branch a stillwater exists above Clare, at the outlet of which is an old lumberman's dam out of use, and above this dam site is a drainage area of 27 square miles. A masonry dam 20 feet high, founded on rock, and built at the site of the old timber dam, would flood 1,200 acres, most of which is lumbered land now covered with stumps and brush and a small portion is swamp. These basins have a storage capacity of a half billion cubic feet below the proposed flow line at elevation of 965.

The DeGrasse basin is long and narrow and involves the two branches of the stream. The basin extends from 3 miles below DeGrasse on the main branch to Clare on the north branch. Two dams would be required, both about 35 feet high, with an aggregate length of 2,000 feet. The flooded area would be 1,600 acres and the storage capacity one billion cubic feet.

The power possibilities on the Grass river, mostly undeveloped at the present time, lie in the 30 miles between Grass river flow and Russell, in which distance the total fall is 950 feet. Below Russell the fall is 400 feet to the St. Lawrence river, but of this only 160 feet is now developed. With improvements at the existing dams at least 200 feet of the fall might be made available. The extensive power development at Massena, on the Grass river, is not properly a Grass river development, as the water is drawn from the St. Lawrence river through a long canal, and the Grass river is practically a tail race for the plant.

The regulated flow from the three reservoirs above described could be used between Clare and Russell, taking advantage of about 180 feet head by diverting dams and long pipe lines. The storage would also increase the possibilities at the existing plants which now use 160-feet head, making possible a development of 6,200 net 24-hour horsepower. The undeveloped sites have a power value of 12,000 horsepower with the stream regulated, which, with the existing plants, would make a total of 18,200 horsepower, whereas at the present time only about 2500 horsepower is developed continuously.

St. Regis River.— This river consists of three large branches, the longest of which rises in the southerly portion of Franklin county, near Saranac Lake, where at an average elevation of 1500 feet above sea level numerous small ponds and swamps among the hills, unite to form the source of the river. This branch flows northwesterly and northerly for 68 miles to the St. Lawrence river at the extreme northerly boundary of the State. The St. Regis has a drainage area above its mouth of 664 square miles. The three branches are the Deer river, and the east and west branches. Two reservoir sites are considered possible on the west branch, one at Sylvan Falls, the other 5 miles above the falls. At the former site a dam 30 feet high and 800 feet long, built to elevation 1120, would flood 1000 acres and impound 1.2 billion cubic feet. The dam site is on bed rock, affording a good foundation for a masonry dam. The basin is covered with second-growth timber owned by a lumber company and it is understood the timber will soon be cut. Five miles above this dam site lies a large stillwater some 5 miles long and averaging half a mile in width, the greater part of which is swamp land. At the outlet of the stillwater is the remains of a timber crib dam. The foundation is rock, upon which a dam 40 feet in height would flood 1,500 acres and impound about 1.8 billion cubic feet. The areas and storage capacities of these two reservoirs have been only approximately estimated from observations taken on the ground. It is probable that both of them have larger storage capacities than the amounts named.

On the east branch there are two storage possibilities, one just above St. Regis Falls, the second above Santa Clara. The St. Regis Falls basin has an area of 1,440 acres, mostly swamps and contains no timber. There is a dam now at this site which, if rebuilt and raised 25 feet, would store 1.5 billion cubic feet. The Santa Clara basin with a dam 40 feet high would flood 620 acres and have a storage capacity of one billion cubic feet, but such a reservoir would flood the tracks of the New York and Ottawa railroad to a depth of 20 feet in some places. It would not be a difficult nor unreasonably expensive undertaking to relocate the railroad tracks and place them above the water level. The topographical conditions and the character of the ground are such that the change could readily be effected.

The west branch, after leaving the plateau in which it has its source, falls rapidly over numerous falls and rapids through rough country for 15 miles to the foothills of the Adirondacks. This succession of falls affords some excellent power development opportunities, only a few of which have so far been utilized, probably the limit of possible power without stream regulation. Just below Lyons Falls there are two falls in the stream within a distance of 1.5 miles totalling 200 feet which are available for power development but only after storage is effected. Also above Parishville several places were discovered where low dams 10 or 15 feet in height with pipe lines to power plants would make serviceable a portion of the fall. Below Parishville to Southville, a distance of 6 miles, the fall in the river is 420 feet most of which is capable of development. At West Stockholm where there is now a development there is an opportunity for improvement and an increased power output.

On the east branch below St. Regis Falls, the river has a fall of 175 feet, 52 feet now being utilized. With regulation of the stream the full 175 feet head could well be utilized at a reasonable cost for development. The fall from St. Regis to Nicholsville, 6 miles, is 335 feet through a rock gorge, most of which might be utilized with reasonable developments. From Nicholsville to Buckton, 7 miles, there is a further fall of 300 feet much of which is possible of development with low dams and long pipe lines. On the Deer river branch little or no improvement can be accomplished without regulation.

The resultant beneficial effect from the four reservoirs at St. Regis Falls, Santa Clara, Sylvan Falls and the Stillwater, with a combined storage capacity of 5.5 billion cubic feet, would be 5,200 net 24-hour horsepower at the present developed power sites, and 32,000 net 24-hour horsepower at the possible new developments, making a total possibility with regulation of 37,200 horsepower.

Salmon River (Franklin County).— There are two rivers bearing this same name in the St. Lawrence river area. The one here referred to rises in the eastern central part of Franklin county near Loon Lake and flows northwesterly into Canada at Fort Covington. Its watershed is 480 square miles above the State line. About 40 miles of its course lies in the State of New York.

One promising reservoir basin was noted in this drainage area, at Titusville, where there is a narrow rock gorge in which if a masonry dam 34 feet high were built a reservoir covering 3,200 acres would be formed over a low swampy tract of land and 2.5 billion cubic feet of water would be impounded. Above the dam site the watershed is 116 square miles. The reservoir basin includes 1,200 acres of state land but all of this lies outside of the Adirondack Park and is covered with small second growth timber partially burnt over.

The available storage in this reservoir would increase the ordinary minimum mean monthly flow below Titusville by 148 c. f. s. This additional flow would be most useful to the existing powers between Titusville and Fort Covington. The principal present development is at Malone where a head of 65 feet is utilized for a development of 3,000 horsepower. In the summer months the output from these plants falls as low as 600 horsepower on account of the shortage of water.

At Titusville there is an opportunity to utilize about 370 feet head now only partially developed and a further possibility of 130 feet head exists between Malone and Westville.

The total power value of the Salmon river with regulated flow from the Titusville reservoir and with the improvement of the existing power sites and the development of new sites is 12,000 net 24-hour horsepower at the minimum.

St. Lawrence River.— The matter of storage does not enter into the consideration of the St. Lawrence river because of its enormous watershed, including the great lakes and because of the constancy of its flow, amounting to about 300,000 cubic feet per second.

Two feasible power sites exist along the river lying wholly within the territory of the state of New York, and without involving any international questions.

At the village of Waddington a dam built across Little river from the mainland to Ogdens Island would make available a head of from 10 to 11 feet. With the water coming through Little river, this head is capable of producing about 30,000 continuous horsepower.

A second site exists near the foot of Long Sault Island, at which point a masonry dam from the mainland to the lower end of the island is feasible provided a rock foundation can be found within a reasonable distance of the bed of the river. Such a dam would make possible a development of 90,000 horsepower under 29 feet head, and would also have a beneficial effect upon the supply of water for the Massena power development now taking water from the St. Lawrence river and discharging into the Grass river.

Several other large power schemes have been, or are now, under consideration on the St. Lawrence river, but as they all involve international questions between the United States and Canada it is thought best not to discuss them in his report.

SURVEYS, WESTERN DIVISION.

No additional surveys have been made on the Portage reservoir in connection with the Genesee river power projects, nor have surveys been made for power studies on any other streams in the western part of the State.

The surveys for the Genesee river improvement described in detail at page 140 of this report, do, however, have an important bearing on the power and storage problems as well as upon flood control. Much study and time was devoted to obtaining data and reliable information in the field in order to make more complete the foundations of our investigations on the Genesee, both in connection with flood control and power development.

RECONNAISSANCE, WESTERN DIVISION.

A rapid reconnaissance of the principal streams west of the cities of Elmira and Oswego was made by the Resident Engineer of the Western Division and the findings are given in detail in his report submitted herewith. The reconnaissance was made primarily for the purpose of determining if any possibilities for storage and power development existed on the western streams which would be worthy of more careful investigations and surveys in the future.

The country in this section of the State is generally rolling but not mountainous. It is crossed by the valleys of several large streams some of which have narrow deep gorges, like the Genesee river at Portage, and the Cattaraugus creek near Springville, but usually the valleys are wide and the streams flow with a practically uniform slope and without cascades or succession of rapids. There are therefore but few opportunities for large power developments in this region, however, a number of smaller mill power sites exist most of which are now utilized to their fullest capacity. This part of the State is primarily a farming country from which most of the forest has been cut. Attention is herein directed briefly to the more important storage and power sites noted.

Cattaraugus Creek.— This stream rises in the southerly portion of Wyoming county and flows westerly into Lake Erie. It falls about 1,100 feet in 40 miles. It has a watershed of 560 square miles above its mouth.

On the main stream no basin was noted of sufficient capacity to completely regulate the flow and control the floods, but several smaller sites were found where sufficient storage could be accomplished to benefit the existing power sites at Springville and Gowanda. One new power site for a possible development was noted which seems worthy of further consideration.

Near the hamlet of Zoar, 8 miles above Gowanda, in a narrow shale gorge, a masonry dam 45 feet high and 350 feet long would impound 850 million cubic feet of water in a reservoir two miles long and averaging one-third of a mile in width. The discharge from such a reservoir would practically double the present minimum mean monthly flow of Cattaraugus creek, making it equal to the natural flow during the fall and winter seasons, or approximately 200 cubic feet per second. The estimated cost of the reservoir complete is $122,000, being at the rate of $143 per million cubic feet stored. The power benefit to be derived from the reservoir would be the addition of about 330 horsepower during the summer months at the present mill sites and a development of perhaps 2,300 horsepower at a new site at present undeveloped. This latter possibility lies near the village of Versailles, 6 miles below Gowanda, where the natural fall of the stream is about 20 feet in half a mile. A dam at the head of the fall 40 feet in height and flooding 250 acres in the gorge would provide a pondage for night storage, which with the storage from the first mentioned reservoir would make possible the development of about 2,300 horsepower for 24 hours a day for nine or ten months of the year. During the three summer months of a very dry year the power output would possibly be reduced one-half. The head under which this power could be developed would be about 55 feet. Such a power development would cost approximately $200,000. Adding to this amount the cost of the reservoir gives a total of $320,000 for the storage and power development, which is at the rate of $140 per horsepower.

Another site was noted near the village of Springville, but owing to the higher value of land and the small drainage area above the point, its practicability can only be determined by a survey and closer investigation.

Minor Streams Tributary to Lakes Erie and Ontario.— Between Niagara Falls and the Genesee river at Rochester there are a number of streams emptying into Lake Ontario, which have on them at the present time power plants of considerable importance, such as the Eighteen Mile creek at Lockport and Oak Orchard creek at Medina, but these developments depend largely for their water upon the discharge or waste from the Erie canal. The country through which the streams flow being generally flat, the storage opportunities are very small. The same may be said of the Buffalo creek, Cayuga creek and Cazenovia creek which flow into Lake Erie, and the Tonawanda creek which flows into the Niagara river between Buffalo and Niagara Falls. All of these latter streams are sluggish in their flow.

Chautauqua Lake Outlet.— The reconnaissance covered the outlet of Chautauqua Lake where at the present time there is a power development, but upon examination of the conditions we conclude that the opportunity for storage upon this lake without interfering with its use as a summer resort is small. However, it would be possible to somewhat improve conditions at the existing power plants so as to obtain better results from the amount of water naturally flowing out of the lake, but we feel that this matter should be left to the wishes of the owners of the power interests at that point.

Upper Genesee.— In addition to the large storage project at Portage, there are several smaller propositions in this drainage area which were investigated under the direction of Mr. Freeman and included in his report of February 1, 1908. A further reconnaissance of the Upper Genesee was made this year which confirms the conclusions arrived at by Mr. Freeman.

On the main river about four miles above Wellsville, an excellent opportunity exists for a dam and reservoir of about two square miles area, with a capacity of probably 850 million cubic feet. The reservoir site is crossed by the main line of the Buffalo & Susquehanna Railroad, which fact makes the feasibility of the proposition questionable, as the cost of relocating the railroad would add greatly to the cost of the project.

On Caneadea creek, about two miles west of the Genesee river, there is a fine dam site at the head of the gorge. A dam 84 feet high at this point would impound probably one billion cubic feet and afford a possibility for a development of perhaps 850 horsepower.

Silver Lake outlet at Perry presents another opportunity which might upon further investigation, prove feasible for storage and power improvement. The drainage area of this stream at the foot of the lake is about 24 square miles. The discharge is estimated at 100 cubic feet per second, for perhaps eight months in the year, but falls as low as 40 cubic feet per second in a dry month. There is slight possibility for storage on the surface of the lake by controlling works at the outlet, but the greater advantage would be a possible improvement of developments at Perry and at Gibsonville by a rearrangement of the plants and the development of power under the full possible head instead of under several smaller heads as at present.

HEADQUARTERS DIVISION.

Summary of Office Studies.— The headquarters office force for the year has varied from a minimum of three in March to a maximum of eight men in September to November, inclusive, and was under the direct supervision of Assistant Engineer, David R. Cooper, into whose charge was put all of the drafting and computing work on March 1, 1909. During the months of November and December, the Resident Engineers, with one or two assistants, finished their work and reports at the headquarters' office.

The force has been engaged in mapping, computing reservoir capacities, executing and revising studies of stream regulation, and in compiling, co-ordinating and studying rainfall and stream flow records in each of the watersheds of the Hudson, Raquette and Genesee rivers. In addition similar work in more or less complete form has been done in the watersheds covered by reconnaissance, such as the Black, Oswegatchie, Saranac, Ausable, Salmon, etc. All available rainfall and stream flow records throughout the entire State have been collected and exhaustive studies made to determine the reliability and value of each and every record. Summarized reports on waterpower developments and power possibilities in the State have been prepared or collected and correlated with other data relating to water storage and power development.

Exhaustive studies have been made of the possibilities of regulating the floods on the Genesee river and the reservoir capacity which would be required for such regulation. The studies include a proposed reservoir in the river gorge near Mt. Morris in comparison with the Portage reservoir.

In connection with the studies of the regulating effect of storage reservoirs, detailed studies have been made which indicate the necessity for what may be termed auxiliary regulating reservoirs on streams where the point of utilization of the stored water is at a considerable distance below the reservoir.

With a view to computing the probable benefits which would accrue to existing and future power developments from the construction of reservoirs on the principal rivers, extensive studies have also been made of the extent and variations of stream flow month by month for a period of several years, to which have been applied the estimated amounts of water assumed to have been discharged from reservoirs, and the resulting maximum, minimum and average power added monthly was computed.

A vast amount of valuable data has thus been collected which is of prime importance in the study of water conversation matters, all of which has been filed and indexed for ready reference. A full and valuable report upon the year's work has been presented to me by Mr. Cooper, but is too voluminous to include in this report. However, the principal subjects will be briefly reviewed below.

Auxiliary Regulating Reservoirs. If it is desired to maintain a constant flow at some power site on the river remote from the storage reservoir, as is the case on the Genesee and Raquette rivers, some system of smaller regulating reservoirs seems to be essential. Otherwise the flow cannot be used at the power site to the greatest advantage if the unavoidable fluctuations due to the time elapsing beween the discharge of the water at the reservoir and its arrival at the power plant are not controlled by some regulating device. The varying demands made upon the storage by the load fluctuations at the power house could not be met except by pondage immediately adjoining the power plant. For example, the distance from Little Tupper lake to Hannawa Falls on the Raquette river is fifty miles or more. Water discharged from the reservoir would possibly reach the power site at a time of day when least useful and therefore be practically wasted unless local pondage capacity were provided.

Summarized Estimate of Power Possibilities in the State.— A revised estimate of the total amount of possible waterpower has been prepared by the use of all available data collected during the past three years. On the streams which have been studied in detail the estimate is based upon data obtained by surveys and inspections, together with a study of the watershed and topographical maps and the profiles of the rivers established by our engineers. Where complete data was not available, computations based upon the estimated regulated flow which would result at each point from the construction of a complete system of reservoirs in the watershed were made in many cases. In each case the object was to make the power estimates conservative and well within the possibilities of the stream. Statistics as to existing developments on the streams were also carefully studied and in many cases these developments were assumed to represent the total power possibilities. The following table shows the existing developments as determined by our census and probably a rather conservative estimate of ultimate power possibilities.

SUMMARIZED ESTIMATE OF EXISTING AND POSSIBLE POWER DEVELOPMENTS IN NEW YORK STATE.

DRAINAGE SYSTEM.	Present development horse-power. (e)	Additional Undeveloped horse-power.	Available development horse-power.
Lake Erie and Niagara	(a) 4,576	(a) 2,900	(a) 7,400
Lake Ontario, minor	17,934	4,000	22,000
Genesee	31,496	55,000	86,500
Oswego-Seneca	57,049	50,500	107,500
Black and Salmon	86,834	107,000	193,800
St. Lawrence	(b) 73,418	(b) 220,100	(b) 293,500
Lake Champlain	49,828	86,600	136,500
Upper Hudson	170,817	209,200	380,000
Lower Hudson	32,602	32,000	64,600
Mohawk	42,698	101,000	143,700
Housatonic	580	1,000	1,600
Delaware	3,369	40,000	43,400
Susquehanna	14,766	18,000	32,800
Allegheny	2,361	2,500	4,800
Total	(c) 588,328	(d) 929,800	1,518,100

(a) Exclusive of Niagara river.

(b) Exclusive of St. Lawrence river.

(c) Only about 450,000 h. p. in actual use in 1908, the utilization of which involves considerable recourse to steam auxiliary power plants of 124,000 h. p. capacity.

(d) Estimated continuous (24 hours, 7-day) power without any steam auxiliary whatever.

(e) Based on census of 1908 by State Water Supply Commission.

A diagram of the power status has been prepared (Plate 1, page 62) to show graphically the relative proportions of the developed and undeveloped waterpower. It shows also the progress of waterpower developments in the State, how it has advanced rapidly since 1890, about which year the first extensive hydro-electric developments were commenced. The advance in the three years from 1905 to 1908 was greater than that of the ten years from 1890 to 1900.

Rainfall Records and Studies.— The daily and monthly records from the rain-gage observation stations which have been maintained for the past three years in co-operation with the United States Weather Bureau, have been supervised, compiled and studied in the Headquarters office. Following is a table of the recorded rainfall at our observation stations for the year 1909:

RECORDED PRECIPITATION AT STATE WATER SUPPLY COMMISSION RAINFALL OBSERVATION STATIONS, IN THE ADIRONDACK REGION, FOR THE YEAR 1909.

MONTH.	RAIN OR MELTED SNOW.							
	Potsdam.	Raquette lake.	Lake Pleasant.	Benson Mines.	Old Forge.	North Creek.	More-houseville.	Nehasane.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January........	2.84	4.86	6.65	3.67	3.06	4.99	4.39	5.06
February.......	2.41	6.25	2.30	3.62	6.91	6.30	5.65	7.01
March..........	2.02	3.19	2.35	3.25	4.81	2.94	5.08	3.73
April..........	2.44	4.50	2.10	3.35	3.35	2.69	3.52	4.37
May...........	5.09	5.49	1.87	4.26	5.92	3.62	4.42	5.36
June...........	1.93	3.96	2.40	1.22	4.21	2.92	2.06	1.86
July...........	4.34	3.67	1.21	4.35	4.35	2.12	4.85	4 68
August........	1.63	1.79	2.15	2.24	2.32	2.48	2.18	2.31
September......	3.02	3.57	0.25	3.02	3.12	1.97	3.48	2.69
October........	3.40	1.51	1.20	1.25	2.33	5.35	3.46	2.39
November......	2.25	3.98	2.10	....	3.47	3.17	3.41	4.09
December......	1.24	3.33	2.35	....	3.20	2.86	2.71	2.86
Total for year...	32.61	46.10	26.93	(a) 30.23	47.05	41.41	45.21	46.41

(a) Ten months only.

The comparative tests of different types of rain gages which was instituted at Ithaca under the direction of Mr. Freeman in 1907, has been continued with interesting results. The data obtained is set forth in the following table, which indicates clearly that the percentage of error in the old records, so far as the type of gage used is concerned, is probably very small, probably never exceeding five per cent. if the observations were carefully taken. The average variation is very much less than this.

Exact information as to the type of gage used in connection with any particular ones of the old records is very difficult to obtain. This fact taken together with the indications of these experiments, seems to warrant the conclusion that a correction factor to be applied to precipitation records secured by the use of the old types of gages is not justified. The errors that are made in measuring and recording the precipitation, whatever the type of gage used, are undoubtedly of sufficient magnitude to make any corrections for the type of gage used an unwarranted refinement.

Summary of Results of Experiments with Different Types of Rain-Gages. Montly Recorded Precipitation, in Inches.

MONTH.	Gage No. 1.	Gage No. 2.	Gage No. 3.	Gage No. 4.	Gage No. 5.	Gage No. 6.	Gage No. 7.	Gage No. 8.
1908.								
May*	(4.55)	5.13	5.36	4.80	5.21	5.37	4.71	4.30
June*	(1.33)	1.82	1.74	1.67	1.85	1.81	1.58	1.26
July*	(5.02)	4.81	4.80	4.77	4.94	4.87	4.50	4.75
August	3.69	3.62	3.66	3.42	3.82	3.82	3.48	3.48
September	1.60	1.53	1.53	1.48	1.53	1.56	1.36	1.61
October	1.68	1.67	1.65	1.76	1.80	1.64	1.61	1.67
November	.97	.90	.91	.85	.93	.90	.79	.89
Total for the series	(18.84)	19.48	19.66	18.75	20.08	19.97	18.03	17.96
1909.								
April	3.48	3.36	3.67	3.13	3.55	3.84	3.27	3.18
May	2.39	2.39	2.37	2.19	2.50	2.51	2.35	2.15
June	4.14	4.14	3.97	4.04	4.27	4.08	4.03	3.97
July	1.70	1.73	1.66	1.63	1.82	1.71	1.61	1.62
August	1.72	1.76	1.70	1.75	1.78	1.70	1.55	1.57
September	2.96	2.97	2.96	3.09	3.11	2.90	3.03	2.90
October	2.29	2.33	2.34	2.33	2.37	2.43	2.36	2.30
Total for the series	18 68	18.68	18.67	18.16	19.40	19.17	18.20	17.69
Total for both series	(37.52)	38.16	38.32	36.91	39.48	39.14	36.23	35 65
Percentage of No. 1	100	101.7	102.1	98.4	105.2	104.3	96.6	95.0

*Precipitation for May, June, July, 1908, gage No. 1, exterpolated from that of gage No. 8 by series totals ratios.
No. 1 is a U. S. Weather Bureau standard gage.
No. 2 is a Smithsonian gage, on the ground.
No. 3 is a Fuertes gage, on the ground.
No. 4 is a Dewitt conical gage, on the ground.
No. 5 is a Smithsonian gage, 10 feet above the ground.
No. 6 is a Fuertes gage, 10 feet above the ground.
No. 7 is a Dewitt conical gage, 10 feet above the ground.
No. 8 is the official Weather Bureau gage located at the office of the Weather Bureau.

Computations of long-term mean dependable precipitation for each observation station in the State have been completed and by means of diagrams a study made of the general relation of mean annual precipitation to elevations. It was found impossible to deduce any general law that would apply to the entire State and

express with any degree of accuracy the relation between these two factors. However, by separating the records according to the Weather Bureau subdivisions of the State, namely, Northern Plateau, Southern Plateau, etc., a fairly uniform relation is found to exist in each of these general divisions where climatic and topographic conditions are fairly uniform. In general, the precipitation increases with elevation, being greatest at the points highest above sea level, but two noticeable exceptions occur, namely, in the Mohawk valley and on the eastern and southern shores of Lake Ontario, in which districts, according to the available records, the precipitation decreases with altitude.

The deduced mean dependable precipitation records have been used in conjunction with these diagrams showing the relation of precipitation to altitude, and with the topographic maps, in the preparation of a long-term isohyetal map of the State. On this map the isohyetals or rainfall contours have been worked out for each two inches of precipitation over the entire area of the State. (See Plate 6.)

From this map and the records we learn that the high altitudes in the Adirondack region have the highest rate of precipitation and are therefore the most prolific in yield of water per square mile of watershed, making their streams more valuable for power purposes. The average annual dependable precipitation in the watershed of the Hudson river above Mechanicville is 43 inches, the average rainfall in the watershed of the Sacandaga is 45 inches, in the watershed of the Schroon river it is 38 inches, in the watershed of the Raquette river above Piercefield it is 40 inches, and on the Genesee river above Portage it is 36 inches. The highest dependable annual rainfall, based upon long-term available records, is 53.6 inches, in the Sacandaga valley in the vicinity of Wells, and the lowest precipitation is 25.3 inches, in the valley of the Genesee river near Mt. Morris.

Stream Flow Records and Studies.— In co-operation with the United States Geological Survey Hydrographic Branch, the maintenance of a number of gaging stations on the Hudson, Sacandaga, Raquette and Genesee rivers has been continued during the year, and the records and results have been reported to this office from time to time, compiled, compared and studied. This branch of the work, taken in connection with the rainfall studies, is of primary importance in the solution of all problems connected with proposed water storage and water power developments.

Considerable time has therefore been expended upon this work by the headquarters force, and Mr. Cooper has visited the most important of the gaging stations being maintained by us in order to familiarize himself with local conditions, and thereby be better prepared to study the possibilities of stream regulation. His visits also reassured us that the stream gaging work is being properly and economically conducted.

Negotiations have also been made in several directions with interested parties, with a view to making arrangements to secure their co-operation in establishing and maintaining new gaging stations so that we may cover a wider field of stream-flow investigation without materially increasing the cost thereof.

A special endeavor has been made this season to accumulate all stream-flow records which might be of service. Accordingly we have secured for our files practically all available records on State and interstate streams from 1868 up to January 1, 1909. In some cases we have the records of the complete year of 1909. The records have been listed and indexed with respect to the important data at each station, showing the names of the station, the locality, the drainage area, type of station, dates when established and when discontinued or re-established, total number of discharge measurements, length of daily gage records and daily discharge records; also the computations for monthly discharge, the total length and character of the record. There are in all 125 stations listed and a map has been prepared upon which the location of every station is indicated.

The hydrographic field work has been under the direct charge of Mr. C. C. Covert, District Engineer of the United States Geological Survey. Mr. Covert's report for the year's work, with full detail records is submitted herewith (Appendix A.).

With reference to the accuracy and value of the past and future work, we are more than ever convinced that the constant interconnection and co-operation between this department and the United States Geological Survey are of great value. It may prove worth while to make further experiments on the method of measuring stream flow in the rough channels of the Adirondack rivers by the one and two point methods and by the installation of recording gages at least on the most important streams. The installation of a recording gage, especially on streams where the daily fluctuations of flow are affected by pondage at power plants and on streams where accurate flood data is desirable, would prove of immense value in studying problems on those particular streams.

Mapping Work.— The mapping work done in the headquarters office includes a complete set in duplicate of the maps of the proposed Genesee river improvement district from Mt. Morris to Rochester, fifty-six sheets in all. These maps have been drawn to a scale of 400 feet to the inch and contain considerable detail showing the location of county, town and village lines, farm boundaries, highways, railroads, streams, bridges and buildings, and they show also the classification of the farm lands, whether woodland, cultivated fields, pastures or swamps. Upon these maps is also recorded the heights to which the floods of 1902 and 1909 rose, from which data the territory covered by the flood waters is clearly defined. A map has also been prepared of the Adirondack region, showing the location of all proposed and future possible reservoir sites and the State lands involved. (Plate 8.) Maps necessary for or incidental to the reports of the Resident Engineers have been prepared in connection with each project. A general map of the proposed Sacandaga reservoir has also been prepared and is reproduced as Plate 9. To show the scope of the studies and investigations a map of the State has been prepared (Plate 10.) on which is shown all storage and power sites that have been investigated. A number of additional maps and diagrams incidental to the year's studies have been prepared and several of the same are reproduced as plates in this report and are described elsewhere.

State Fair Exhibit.— In response to a request from the Department of Agriculture to your Commission, an exhibit was prepared for the State Fair held at Syracuse, September 12th to 19th. The exhibit consisted of diagrams, maps and photographs showing the work of your Commission along the several lines relating to water supplies, river improvement, water storage and water powers. The exhibit was prepared and installed under the direction of

Mr. Cooper, who with Commissioner Acker and the secretary represented the Commission during the week of the fair. This exhibit attracted considerable favorable attention and was instrumental in awakening a wide interest in the work of the Commission. We believe the educational results of the exhibit more than compensated for the time and money expended upon it.

STATE LANDS INVOLVED IN STORAGE PROJECTS.

Surveys, studies and a complete revision of the estimates have been made during the past year to correctly determine the amount of State land which would be involved in the reservoirs which have been proposed, suggested, found practicable or studied in the Adirondack park and the Adirondack preserve. In such surveys and studies there has been included every reservoir, however insignificant as a regulator of the stream flow, and every existing lake upon the surface of which it has been proposed to store water for summer use. Necessarily in such a study there has been included a number of reservoir sites which never will be utilized because they are impracticable. There are also a number of smaller reservoir sites which would not be needed in the event of one or more larger storage reservoirs being constructed in the same watershed. As an illustration of this, upon the Sacandaga river there are three possible reservoir sites, one with a dam at Conklingville, the second with a dam at Little Falls on the west branch of the Sacandaga, including the Arietta flow and Piseco lake, and the third including the lakes Sacandaga and Pleasant. The second and third reservoirs involve 6,500 acres of State land, but in the event of the construction of the dam at Conklingville these two reservoirs would not be needed for a number of years, if at all, and the 6,500 acres of State land may never be required. If, however, the Conklingville dam is not built the two reservoirs might be constructed to advantage for the control of the Sacandaga river. Again, on the Raquette river, if one large reservoir is built to include Big Tupper lake and the valley of the river up to the foot of Raquette Falls, involving 5,025 acres of State land, it will not be necessary to construct the four or five smaller reservoirs suggested for that watershed, and in which 6,395 acres of State land are included. Forked lake and

Long lake, the two of the five which are most feasible for storage, involve only 2,410 acres of State land.

The total amount of State land involved in all of the reservoir sites surveyed or studied during the past three years is 54,923 acres, as shown upon the following table. All amounts of land in the table refer to land the title of which is in the State of New York on December 31, 1909, as per maps and reports of the Forest, Fish and Game Department:

TABLE OF RESERVOIR SITES INVOLVING STATE LANDS IN THE ADIRONDACK REGION.

WATERSHED.	Reservoir site.	Elevation of flow line above sea level.	STATE LANDS INVOLVED.			
			To be flooded.	Required above flow line.	Total.	Grand totals.
			Acres.	*Acres.*	*Acres.*	*Acres.*
First Stage of Development (Immediately Practicable)						
Schroon	Schroon Lake	840	150	50	200	
Saranac	Lower Sacanac lake	1544	3,680	320	4,000	
Saranac	Franklin Falls	1455	26	24	50	
Saranac	Union Falls	1395	200	25	225	
Black	Kenwells	1880	......	......	4,000	
Black	Beaver Flow	1448	6,030	......	*6,030	
Oswegatchie	Cranberry lake	1545	......	......	†7,080	
Raquette	Tupper lake	1570	4,100	925	5,025	
Raquette	Forked lake	1762	......	......	1,030	
Salmon (North)	Titusville	1320	1,170	......	1,170	
Ausable	Cherry Patch pond	1700	262	13	275	
						29,085
Second Stage of Development (May be Practicable Within 10 to 25 Years).						
Hudson	Cedar river	1680	342	48	385	
Hudson	Indian river	1660	3,720	360	4,080	
Schroon	Blue Ridge	1200	82	38	120	
Schroon	Schroon Falls	900	32	68	100	
Saranac	Upper Saranac lake	1580	2,782	218	3,000	
Black	Hawkinsville	1100	33	......	33	
Raquette	Long lake	1635	......	......	1,380	
Canada creek, E	Powley	1700	......	......	1,200	
Canada creek, W	South Branch	1700	152	48	200	
Canada creek, W	1st Stillwater	2200	......	......	500	
						10,998
Third Stage of Development, (May be Practicable Within 25 to 50 Years)						
Hudson	Cheney pond	1760	736	104	840	
Hudson	Cedar river flow	2120	775	45	800	
Hudson	34-Marsh	1800	772	53	825	
Hudson	Chain lakes	1615	143	22	165	
Hudson	Rock lake	1720	454	66	520	
Raquette	Blue Mountain lake	1794	......	......	25	
Raquette	South pond	1766	......	......	80	
Sacandaga	Piseco and Arietta	1675	5,300	530	5,830	
Sacandaga	Lakes Pleasant and Sacandaga	1735	1,200	120	1,320	
Schroon	Chilson lake	958	5	20	25	
Canada creek, E	Stewart landing	1580	64	136	200	
						10,630
Fourth Stage of Development (Probably Impracticable).						
Hudson	Harris lake	1575	77	23	100	
Raquette	Raquette lake	1765	......	......	3,960	
East Canada creek	Morehouse lake	2000	......	......	150	
						4,210
						54,923
Deducting for lands under water in first stage		......	......	......	9,680	
For third stage, which will probably never be built, if the reservoirs of the first and second stages are constructed		......	......	......	10,630	
For fourth stage,—Impractical		......	......	......	4,210	
						24,520
Net total of State land probably required		......	......	......	......	30,403

* State land now under water 3,200 acres

† State land now under water 6,480 acres.

Total .... 9,680 acres.

The reservoir sites in the above table are classified under the four stages of development substantially in the order of their practicability and the probable market demand for stored water. In addition to the sites listed in the table there are several large reservoirs projected where no State land is involved, which in the matter of importance and practicability will doubtless claim first attention in any adopted plan of water conservation.

If from the grand total of 54,923 acres of State land there is deducted 9,680 acres now under water in the Beaver flow and Cranberry lake reservoirs, there remains only 45,243 acres as the net total of additional State land involved in the whole scheme.

A further deduction may be properly made for the 4,210 acres in the fourth stage because the construction of these reservoirs is extremely doubtful, and 10,630 acres in stages two and three for land in small basins which will not be required if larger ones are built. The net total then becomes 30,403 acres.

In the report of last year it was stated that 20,000 acres of State land would be sufficient for the construction of a most complete system of storage reservoirs in the Adirondacks. This statement was based upon an estimate made at that time using the best data accessible and upon the theory that the larger proposed reservoirs would be constructed in each watershed instead of a series of smaller ones. It was the opinion of your engineers then that 20,000 acres of land owned by the State on December 31, 1908, would be all that would possibly be needed for reservoir construction within at least the next fifty years. We are still of the opinion that if the plan of larger reservoirs is carried out not more than 25,000 or 30,000 acres of land now owned by the State will be flooded by all of the reservoirs which one can reasonably anticipate will be built within the next two or three generations. In preparing the estimate for State land this year, we have included not only the land now under water and the land to be actually inundated, but have allowed a strip round each reservoir up to what may be termed a "taking line." This was done for the purpose of having sufficient land surrounding each reservoir to be well above the flow line and out of danger of damage from the action of the water. In the event that such a strip of land is acquired it would not be necessary to denude it of timber for more than about five feet above the normal level of the reservoir surface.

Of the total land included in the estimate table about 75 per cent. is swamp or waste land. The balance is divided approximately as follows: Cultivated land 2 per cent., burned over land 10 per cent., good virgin timber land 3 per cent. and lumbered land 10 per cent.

Plate 3, page 100, is a diagram showing the comparative sizes of the Adirondack park, the area of land owned by the State within the Adirondack park on December 31, 1909, and the total area of State lands required for all reservoirs named in the preceding table, namely, 55,000 acres. It will be seen from this diagram that the amount of land required is only about one and three fourths (1.75) per cent. of the total area of the Adirondack park and that the good timber land which would be involved in all of the reservoirs is but one third (.33) of one per cent of the total area of Adirondack park. These facts clearly demonstrate that were it to be conceded for the sake of argument that reservoirs in the Adirondack park would be a detriment or deprive the public of the enjoyment of a portion of the land, the amount so used is of trivial consequence when compared with the amount of forest remaining. We do not concede, however, that the formation of reservoirs would be a detriment to the Adirondack park or would interfere one iota with the public's enjoyment of the park and its privileges. Much of the territory which would be flooded is now inaccessible owing to its swampy condition, or unattractive because of its unsightly dead timber. To flood such swamp lands will be a benefit far in excess of any possible damage which may result from the necessary cutting of timber on that portion of a reservoir which is not swamp.

A map of the Adirondack region, Plate 8, is herewith submitted, upon which is shown all of the reservoirs in the Adirondack region, which have received the attention or study of your engineers together with the location of State lands involved. At a glance it may be seen how extensive has been the study and how numerous the reservoirs.

Your engineer understands that before any State land can be used for reservoir or power purposes, the Constitution would have to be amended so as to permit of cutting timber on the lands. It has been suggested that if the Constitution is amended, such amendment should definitely state and describe the exact amount of land involved in each and every project so that if any one of them should be carried out no more land could be utilized than that stated in the amendment. Would it not be wiser, instead of limiting in this manner the amount of land which may be appropriated to its own use by the State, to provide in the constitutional amendment that the amount of land utilized by the State for storage reservoir purposes shall not at any time exceed, say 2 per cent. of the State's holdings within the boundaries of the Adirondack park, and that no lands may be taken for reservoir purposes except by and with the consent of the Governor and the Legislature? Such a method would safeguard the State's possessions against abuse or unnecessary reservoir construction by giving the chief executive power to disapprove of any project which, in his judgment, is unnecessary or unwise. We recommend that provision be made in the legislation for the development of the water resources of the State, that the value of any State lands taken for reservoir purposes shall be considered a part of the cost of the project and shall be included in the estimates for the project at the price which the said lands actually cost the State. Also that for the lands thus taken, their value shall be transferred from the water storage fund to the land purchase fund and the State Land Board be required to purchase with such funds an equal value of land in the Adirondacks. Under this plan the State's land holdings will not be diminished and the people will be compensated for any State land utilized for reservoirs by receiving in return an equivalent in land which, in most cases, would be of far more value for health and pleasure than that which is converted to storage purposes.

SUMMARIZED CONCLUSIONS AND RECOMMENDATIONS.

The attention of your engineers has been devoted, as its ultimate object, especially to three sections of the so-called Fuller Act under which the water power investigations have been made. This act requires three specific actions on the part of the Commission in connection with its final report on the water power possibilities in the State of New York. These three requirements involving engineering questions are as follows:

I. The commission "shall devise a comprehensive and practical plan for the general development of the water powers of the State."

II. The commission "shall specifically designate and recommend what work in their opinion shall be first undertaken and what work shall be thereafter undertaken in the order of importance thereof to the State."

III. The commission "shall submit a draft of a bill for a general law providing for carrying its recommendations into effect."

These requirements have received careful study by the engineering department ever since the work was undertaken and have been the keynotes of their investigations. The more study that is given to them the more complicated and difficult seems the task of their solution, but such conclusions as your engineer has come to are as follows:

(I.) As a general principle, the policy or plan of the State for the progressive development of its water powers under State ownership and control should be to construct water storage reservoirs, first, upon the principal streams where a market for the water is already established upon a substantial and going basis and where the power owners are sufficiently anxious for the improvement to be willing to pay for benefits. Thereafter, the development should be in the order of applications made for the improvement, provided such applications are founded upon a real necessity and the applicants are willing to meet the conditions as to payment for the benefits received.

The State's policy should be one which will encourage private investment in water power development within its borders so that the fullest advantage may be taken of the water stored in its reservoirs, and a proper revenue assured to the State on its investment. A policy of State ownership and control of the private power plants on all of the streams of the State or the absolute control of all of the water rights in the State seems too radical a measure to be suggested at this time, if it may ever be seriously considered.

In making a selection of the reservoirs to be constructed, those of the largest capacity consistent with the size and run-off of the watershed above the proposed dam site should receive first consideration in preference to a number of smaller reservoirs, although the latter might have a combined storage capacity equal to that of the large one. The object of the reservoirs should naturally be to store the flood waters of the winter and spring seasons, hold them until the beginning of the dry weather period of the succeeding summer and then release them so as to yield the greatest possible benefit to the existing and possible water power developments upon the stream, and at the same time to prevent flood damages as far as practical.

The power consuming industries thus benefited by the regulated flow of water should be required to pay to the State such a revenue as will defray the cost of operating and maintaining the reservoir system, the interest upon the original cost of construction and provide a sinking fund for the retirement of the bonds. In addition the State should derive a reasonable profit from the undertaking to compensate for the use of its credit and the risk taken.

In the judgment of your engineer, it would be an unjust and a very unwise policy for the State to undertake to generate, transmit and market electric power, especially in a district which already has its established power and manufacturing plants, for by so doing the State would enter into competition with the same private interests which it proposes to tax for the benefits derived from storage reservoirs owned and operated by the State. A plan which contemplates the storage of flood waters for summer use to increase the value of private power rights, for which benefits the beneficiaries shall make adequate payment, appears to your engineer to be a more just and workable one. But if a situation is found where a storage reservoir should be constructed to prevent flood damage and conserve the water for power, and where the market for power is greater than the existing plants can furnish and also where power can be economically developed at or near the reservoir without injury to the other power sites on the stream, then, in that case, the State might properly permit a development at the reservoir by private capital under a lease of the water rights from the State, provided, however, that such power development and the draft upon the storage reservoir shall be made under the direction of the State so that the other private interests below the site of the reservoir will receive their full share of the benefits for which they are to be charged.

In determining whether or not a certain reservoir should be built for power purposes, the governing principle is the practicability of the scheme from an engineering standpoint; the second controlling principle is whether or not the users of power on the stream are sufficiently anxious for the improvement to be willing to make adequate payment for the benefits they would derive from the storage system, and the third is its future possibilities for increasing power developments upon the stream.

(II.) Regarding a recommendation as to what work should first be undertaken under a plan for the progressive development of the water powers, I beg to suggest that of the possibilities so far studied they be considered in the following order:

1. (a) Sacandaga reservoir with dam at Conklingville.
   (b) Schroon lake reservoir with the dam at Tumblehead Falls. This is to be considered as an alternative for the Sacandaga reservoir.
2. Portage reservoir on the Genesee river with dam at the "Rafter site" above Portage Falls.
3. Little Tupper and Round lake reservoir on the Bog river branch of the Raquette river with a dam at the outlet of Round lake.

Sacandaga Reservoir with Dam at Conklingville.— This reservoir appears to your engineer to have many features recommending it to first position for construction, namely:

(a) The reasonable cost of the complete reservoir for the very large storage capacity.

(b) A ready market at existing power plants appealing for the installation of a system of storage reservoirs.

(c) The land flowed is as a whole of comparatively small value, much of it being swampy.

(d) There is now no State land involved in the proposition. Your engineer understands that the small parcel of land lying within the basin of the proposed reservoir heretofore considered as State land is in reality not subject to the constitutional prohibition and therefore can be properly taken and used for reservoir purposes.

(e) A partial control of the flood waters of the Hudson river would be accomplished and a material increase in the power value of the stream affected at the numerous power sites already developed between Troy and Corinth.

The estimated cost of the complete Sacandaga reservoir, including the dam, land damages, change of highways and change of railroad, but without provision for power development, is $4,650,000. Basing an opinion upon the studies of the past year, we are inclined to believe that this estimate, which appears in your previous reports, is a high one and more than ample to cover all costs of the contemplated work. The capacity of the reservoir with the flow line tentatively considered at elevation 770, is 36.5 billion cubic feet, but if the lowest draft upon the storage is limited to elevation 740, the available storage would be 29 billion cubic feet. The cost per million cubic feet available storage is $157. The estimated annual carrying charges, including maintenance, operation, interest and sinking fund provision is $237,700. The estimated gross annual revenue, based upon the increased power to existing power plants, is $427,500. If properly operated, the discharge from this reservoir would increase the minimum flow of the Hudson river at Spiers Falls from 700 cubic feet per second to 2,920 cubic feet per second, and would add 85,500 horsepower in the aggregate to the maximum possibilities at the existing power plants, with the minimum unregulated flow of the stream.

Plate 7, opposite, illustrates the regulating effect in the vicinity of Spiers Falls which may be expected from the Sacandaga reservoir in a dry year. Figure 1 shows the natural flow of the stream from October, 1907, to October, 1909, one of the driest periods of recent years. Had the reservoir been built, the stream flow at Spiers Falls would have been practically as shown in figure 3, where a flow never less than 2,920 cubic feet per second would have been maintained through the two years. Figure 2 illustrates the relationship between the water from the whole Hudson river watershed to that which would have been stored in the Sacandaga reservoir between October and February, 1907, and between January and April, 1909, and shows how the stored water would have been used between June and December, 1908, and again in the following season from the first of July through the balance of the summer, indicated by the red areas. The yellow areas represent flood water unavoidably wasted, most of which comes from the portion of the watershed not controlled by the Sacandaga reservoir. By comparing these diagrams with Plate 2, page 64, one can readily see the relationship which the Sacandaga reservoir bears to an ideal ultimate regulation of the Hudson river flow. The map of the proposed Sacandaga reservoir submitted herewith as Plate 9 will be of interest in connection with the portions of this and previous reports relating to the Sacandaga.

The Schroon Reservoir with Dam at Tumblehead Falls.— This reservoir is an inviting proposition for the partial control of the flow of the Hudson river and has many advantages but some disadvantages affecting its consideration for immediate construction. Mr. Freeman and Mr. Ropes in their reports of last year inclined to the opinion that the Schroon reservoir was a more practical proposition for immediate consideration than the Sacandaga. Were it not for the question of flooding State lands, the Schroon project might properly be undertaken before the Sacandaga. Among the advantages of this reservoir as compared with the Sacandaga are the following:

(a) Its control of the flow of the Schroon and Hudson rivers to the extent of about 60 per cent. of that which would result from the Sacandaga reservoir and at 41 per cent. of the cost.

(b) It presents an additional market for the water at Warrensburg and Hadley.

(c) The land damages in the reservoir would be lower at the present time than they ever will be in the future for the reason that the shores of the included lakes are being settled by summer resorts and pleasure camps. It is highly probable that the unoccupied land surrounding Schroon lake will soon be put upon the market for camp and cottage sites, and the land values will naturally increase with each new settlement.

The following conditions are adverse to the immediate carrying out of this project:

(a) State lands are situated in the reservoir basin and would have to be cleared of timber before being flooded.

(b) During the storage period of the year, the power developments at Warrensburg would be more or less effected by the diminished flow in the stream while the reservoir is filling and would doubtless claim damages.

(c) If the water in the reservoir is raised to the proposel level it would flood a large portion of the villages of Chestertown, Pottersville and Schroon Lake and would necessitate the removal of the hamlets of Adirondack, Horicon, South Horicon and Starbuckville. It would also necessitate the moving of summer hotels and private cottages, all of which would naturally arouse strong opposition.

Your engineer questions the wisdom of beginning the construction of water storage reservoirs at a site including a lake or chain of lakes similar to those included in the Schroon reservoir project and upon which pleasure resorts have been established and where a considerable area of State land is involved. The State land issue, and opposition from private land owners on the shores of Schroon lake, and the further possible opposition to the scheme from various civic and other societies, would tend to delay all work on this proposition from two to five years.

Village lands and buildings are involved in the Sacandaga reservoir also but we do not anticipate any very strong opposition from this source.

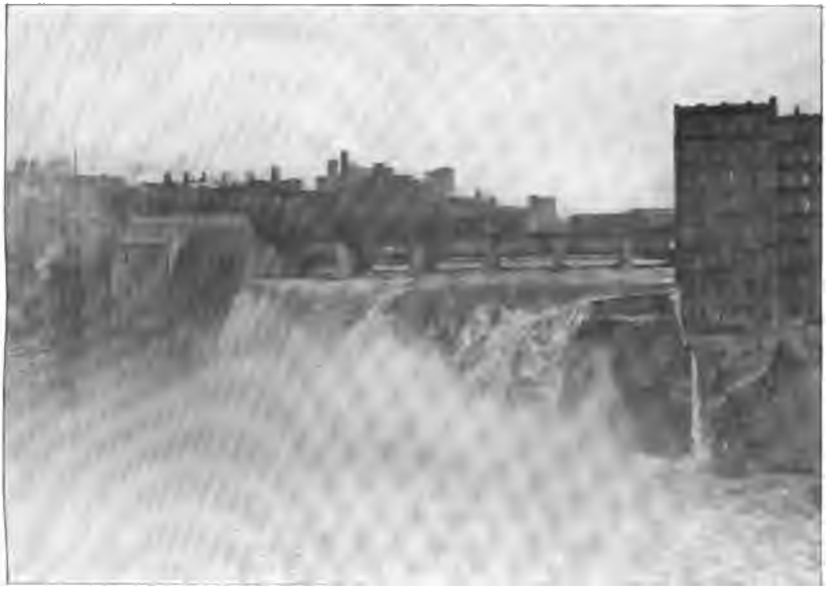
The cost of the Schroon reservoir complete is estimated at $1,900,000, and the storage capacity with the flow line at elevation 840, is 16 billion cubic feet. The cost of storage per million cubic feet is $121. If properly operated, the discharge from the reservoir will add to the minimum flow in the Hudson river in an ordinary dry year, 1,100 cubic feet per second and would add 52,000 horsepower in the aggregate to the possibilities at the existing power plants below the reservoir site, above what can be developed at the minimum flow of the unregulated stream. The annual carrying charges of this project are estimated at $108,000 and the annual gross income based upon the value of the greatest power increase, is $260,000.

Taking all things into consideration, I recommend the Sacandaga reservoir with a dam at Conklingville as the first project to be undertaken in the Hudson river watershed, but before any construction work can properly be done upon this proposition it will be necessary to spend at least one more season making surveys and investigations for the proper, economical and safe location for the dam and spillway and for further study to determine the most economical elevation at which the flow line of the reservoirs should be established, the probable effect on floods and benefits to existing water powers. Surveys must also be made for the relocation of highways and bridges. This additional information is absolutely required before complete working drawings, specifications and close estimates of cost can be prepared.

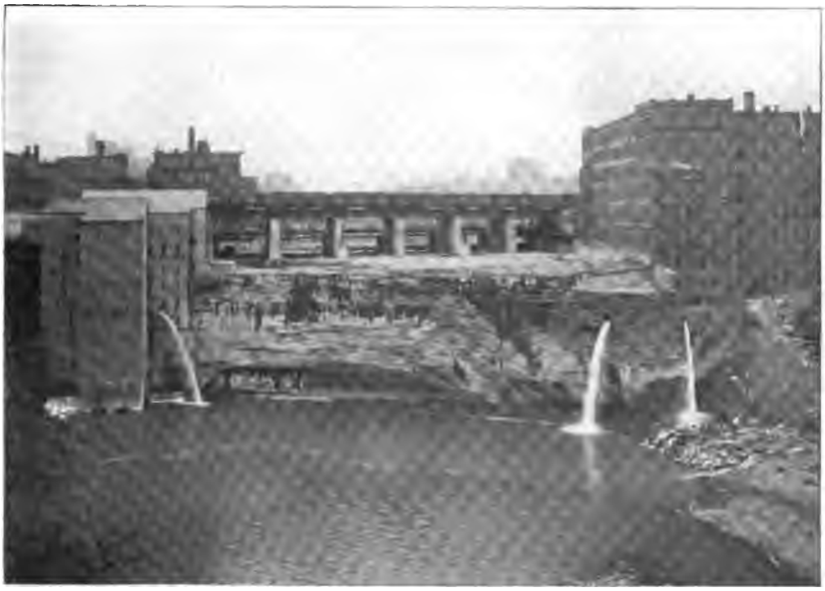
Portage Reservoir.— The Portage reservoir on the Genesee river with the dam at the so-called Rafter site, affords many features making it attractive for immediate development, comparing favorably with the Sacandaga reservoir on the Hudson river. This reservoir would afford almost absolute control of the flood conditions in the lower Genesee valley, affecting some 30,000 acres, and it would materially improve the sanitary condition in the city of Rochester by diluting the sewage which is now emptied into the lower river and becomes stagnant and offensive in the summer months. It would also greatly increase the power value of the stream, principally in the city of Rochester, but also at Mt. Morris. If the latter locality should take advantage of the regulated flow, its power possibilities could be greatly increased. There is also a possibility of a large power development in connection with the reservoir and it seems that an immediate market might be found for the output.

The information which we have gained from additional stream flow records and new studies which have been prosecuted to determine the regulating effect which would result from this storage reservoir, goes to confirm our opinion expressed in last year's report, viz: That the Portage reservoir is commercially feasible only when considered for the combined purposes of the development of power at or near the reservoir, the improvement of power at Mt. Morris and Rochester and the protection of property against flood damage, unless the power interests to be benefitted are willing to guarantee an income to the state of not less than $200,000 per annum.

Our studies of this year show that last year's estimates of cost and power benefits were conservative.



Genesee River — Rochester, May 4, 1909.
This waste of flood water would be prevented by the proposed Portage reservoir.



Genesee River — Rochester, October, 1908.
The site of the falls in usual summer condition.

Following are condensed statements of the estimated costs of the reservoir, the estimated revenue and cost of maintenance:

Plan A:

Estimated cost of the Portage reservoir with a dam at the most practicable site but without provision for power development		$4,518,000 00
Estimated annual maintenance charge including interest and sinking fund		200,000 00
Estimated gross annual revenue from power added at Mt. Morris and Rochester	$115,000 00	
From flood control and sanitary improvement	35,000 00	
		150,000 00
Deficit		$50,000 00

Plan B:

Estimated cost of Portage reservoir with dam at the most practicable site and an intake, pressure tunnel and power house for power development, but without machinery		$6,800,000 00
Annual fixed charges on the above, including interest and sinking fund		300,000 00
Estimated gross annual revenue: —		
From power development at the reservoir	$300,000 00	
From power improvement at Mt. Morris and Rochester	115,000 00	
From river improvement in the Genesee valley and in the city of Rochester	35,000 00	
		450,000 00
Net revenue		$150,000 00

The estimated cost of the Portage reservoir is comparatively higher per million cubic feet of storage capacity than some of the large reservoirs under consideration on other rivers, due principally to the high value of the real estate and the necessity of changing the Pennsylvania Railroad, but if the project is carried out under above Plan B, the burden of cost will fall within reasonable limits upon each interest when equitably divided between the power development at the reservoir, the power betterments at Mt. Morris and Rochester, the sanitary improvement of the river in the city of Rochester, and the 30,000 acres of land in the lower valley protected against flood damage.

Little Tupper Lake Reservoir.— The Little Tupper Lake proposition is attractive as one which might be undertaken early in the plan of development on account of the low cost of construction and the fact that there is no State land involved in it, also that there are water-power plants upon the Raquette river which would receive immediate benefit from the regulating effect of this reservoir. As the most of the land surrounding Little Tupper Lake and Round Pond is owned by one individual, there are no buildings except at the camp on the Whitney estate to be affected by raising the level of the two lakes included within this proposition.

The studies made this year as to the effect and benefits to be expected from the Little Tupper Lake reservoir lead to the conclusion that the regulation of the flow at the principal power site on the river, namely, Hannawa Falls, would not be as steady and as advantageous as was at first anticipated for the reason that some 50 miles intervene between the reservoir site and Hannawa Falls in which distance there is a fluctuating flow in the river due to rainfall and run-off conditions in the uncontrolled watershed. Although the water discharged from Little Tupper Lake will add somewhat to the power value of Hannawa Falls and the mills on the river below Hannawa, yet a constant and even flow cannot be guaranteed to these several water-powers. The proposition would, however, be valuable to the power interests by insuring not less than a given flow of water in the driest year to be expected, or by being used to increase their power output in varying amounts each year. It would also be serviceable in the dry period of winter when the water could be withdrawn with perfect safety and with assurance that the following spring would replenish the storage.

Considering that whatever storage is provided in this portion of the watershed would be used for the best regulating effects on the lower river a study has been made with considerable detail to determine the added power at each of the exisiting plants on the lower river for each month of the last six years during which stored water would have been released from this reservoir had the same existed. It has been noted that should this reservoir have been used to regulate the stream in the vicinity of Colton for the rate of flow which could have been maintained constantly throughout the summer of 1908, the resulting regulated flow would have been about 625 cubic feet per second, and also that even this regulated minimum flow was exceeded by the minimum natural flow of the stream for most of the time during the previous five years. This indicates very clearly that should the reservoir have been built and operated to produce a maximum regulated flow of 625 cubic feet per second there would have been no need for it during the five year period preceding 1908. There is very little doubt that the investment of $300,000 or $400,000, the estimated amount required to provide this storage, would not be warranted in case the stored water should be used only once in five years. The possibility of doing this is so unreasonable that it has been eliminated from the studies and the assumption has been made that the reservoir would be used at least in part, every year. For the purpose of computing added power on the stream below and estimating the annual benefits to be derived from this storage as a basis for determining its economical feasibility it has been assumed that the reservoir would be operated to produce a minimum regulated flow equal to the minimum which it would have produced in the five year period previous to 1908 by completely emptying the reservoir. This rate is found by mass curve computation to be about 1,135 cubic feet per second which would have emptied the reservoir entirely in the year 1907.

It should be noted that this method of regulation contemplates that in an unusually dry year the reservoir would be emptied in the fall and that thereafter till the succeeding storage period, the natural flow of the stream would be all that would be available for power purposes. Also that by regulating for this rate of 1,135 cubic feet per second the reservoir at Little Tupper and Round

Lakes would have sufficed for the period of five years previous to 1908, and that during 1908 the reservoir would have been emptied about the end of September, after which time the natural flow of the stream is all that would have been available for power developments. A similar situation would apparently have existed in the year 1909 so far as may be determined by the records available at this time.

Whether or not this method of regulation is the one which would be adopted in connection with such a comparatively small reservoir it is at least in general the only method by which the Little Tupper and Round Lake storage reservoir may be made to pay interest on the investment. Accordingly the studies of added power and yearly benefits have been made on this basis. Following is a table showing the computed monthly added power at the existing plants on the stream below Piercefield and a corresponding estimate of the money value of this power which indicates that on the average the stored water in this reservoir, if released as contemplated by this study would represent yearly benefits to the existing plants and within their present water-wheel capacities, to the value of about $90,000.

ESTIMATED INCREASE OF POWER ON THE RAQUETTE RIVER DUE TO STORAGE IN LITTLE TUPPER — ROUND POND — SLIM POND RESERVOIRS.

(Combined capacity 2,528,000,000 cu. ft.)

	Total added power in H.P. years.	WITHIN PRESENT WHEEL CAPACITY OF PLANTS.			NOT WITHIN PRESENT WHEEL CAPACITY OF PLANTS.		
		Added power in H.P. years.	Estimated coal equivalent at 10 tons per H.P. year.	Estimated annual average value of added power at $44 per H.P. year.	Added power in H.P. years.	Estimated coal equivalent at 10 tons per H.P. year.	Estimated average value of added power at $20 per H.P. year
			Tons.			*Tons.*	
1904	2,505	2,300	23,000	$101,200	205	2,050	$4,100
1905	305	240	2,400	10,550	65	650	1,300
1906	2,140	1,925	19,250	84,750	215	2,150	4,300
1907	2,780	2,615	26,150	115,000	165	1,650	3,300
1908	2,915	2,830	28,300	124,500	85	850	1,700
1909*	2,465	2,365	23,650	104,100	100	1,000	2,000
Total	13,110	12,275	122,750	$540,100	835	8,350	$16,700
Average	2,185	2,045	20,450	$90,000	139	1,390	$2,780

* Through August, 1909.

The above estimate does not represent the total value of this storage, since it does not make any allowance for powers at present undeveloped. The values computed are on the basis of cost of auxiliary steam power. This method of computing the probable value of power added by storage and stream regulation has been used here as an example for comparison with other methods of preliminary estimates heretofore used in our reports of this and previous years. While this method shows the equivalent steam-power value of the added water power it does not necessarily form the basis for fixing the amount which the beneficiaries would be required to pay. It remains to be determined what proportion of this value would be a reasonable charge for the added power, and to what extent the value of the undeveloped powers would be increased and what, if any, are the corresponding benefits to them.

III. Draft of Bill for Water Power Development.

Your engineers have been called into consultation with you so frequently during the preparation of the bill to carry into effect a State policy or plan for the general progressive development of the water powers of the State that nothing of additional interest on this subject can be set forth in this report. The proposed bill as you have drafted it in its general form and principle, as regards its engineering features, has the approval of your engineer, but we realize that any draft of a bill dealing with a matter of such vast importance as the one under consideration is necessarily susceptible of amendment and improvement after the views of all interested parties are obtained.

Future Work.

The work contemplated in the Fuller act has not been completely finished owing to lack of time and funds to cover so large a territory as the State of New York, but that which has been accomplished conclusively demonstrates the great possibilities for the conservation of the State's water resources.

The watershed of the Hudson river below Albany, the Susquehanna, the Mohawk, the Oswego and other important drainage areas remain to be carefully studied before the investigations can be considered practically completed.

Consideration can properly be given also to the possibilities of improving the smaller streams, which, if developed, would revolutionize the farming industries in the State by furnishing not only light and power for the farm work, but also water for irrigation purposes.

It is especially important that the collection of rainfall and stream flow data be continued, and that the existing rainfall and stream gaging stations be maintained without interruption. It is also very desirable that new stations be established in all of the principal watersheds and upon the principal power streams not now provided with such gaging stations. The hydrographic work begun and accomplished under the Fuller act should not be lost to the State but should be continued and extended upon a comprehensive basis. Reliable data in regard to rainfall and run-off in the various watersheds is the foundation upon which all accurate study of the power value of a stream depends, for in rightly considering the value of any stream for storage or for power development, the essential data upon which proper judgment can be based is the dependable amount of rainfall and of run-off. The value of these records depends largely upon their continuity, the length of time during which they have been taken and the care exercised in obtaining, compiling and preserving them. For the purpose of this work an annual appropriation should be made to enable the Commission to continue investigations in co-operation with the United States Government in a manner that will insure accuracy and thoroughness in the collection and preservation of the records.

Other data should also be collected in regard to all important reservoir and power sites, in order that there may be reliable information at hand for ready reference. Such information when collected and classified would prove of sufficient interest and importance to warrant the expense incurred in collecting it. Even if no construction work on storage reservoirs is authorized in the near future, the subject of water conservation is one which is going to be forced upon the attention of the people, and sooner or later, must be undertaken. When it is actively undertaken, the above described data will be of immense value.

If the water power investigation is to be continued, your engineer would respectfully suggest the advisability of putting the engineering work upon a more permanent basis than now prevails, so that its work and force of men will not be disorganized at the close of each succeeding season by the depletion of the appropriation, as has been the case in the past. During the past three years the work of the Engineering Bureau has been greatly hampered, disorganized and delayed by the necessity of laying off practically all of its men at the end of the season and taking on new ones the following year. Such a condition has resulted in expensive work which might otherwise have been done more economically and quickly, but under the circumstances there seemed to be no way of avoiding this situation for the amount of work undertaken each season, although of great importance, was, nevertheless, out of all proper proportion to the amount of time and money available.

Your Commission has in its engineering force several men eminently qualified for the work of investigation on hydraulic enterprises, and whose experience in this department during the past year or two makes them of special value to the work in hand, but the depletion of the funds at the end of this year will make it necessary to dispense with their services, and, in all probability, they will accept employment elsewhere and be lost to us.

The engineering force has been reduced to four resident engineers, one assistant engineer, one draftsman and two tracers, and on February 1st we will be obliged to dispense with the services of the four resident engineers for lack of funds.

Respectfully submitted,

WALTER McCULLOH,
Consulting Engineer.

II.

REPORT OF JULIAN THORNLEY, RESIDENT ENGINEER,

ON

RECONNAISSANCE OF THE BLACK, OSWEGATCHIE, SALMON, ST. REGIS AND GRASS RIVERS.

ALBANY, N. Y., *December* 31, 1909.

Mr. WALTER McCULLOH, *Consulting Engineer, State Water Supply Commission, Albany, N. Y.:*

DEAR SIR.— I have the honor to present the following report upon the reconnaissance made by me in the watersheds of the Salmon (Oswego county), Black, Oswegatchie, Grass, St. Regis and Salmon (Franklin county) rivers to determine, as fully as possible, the location and extent of the storage possibilities in the several watersheds, the increase in the developed and undeveloped power of the streams which would result from the utilization of this storage for stream regulation and the extent to which State lands would be thus affected. With this in view, after some preliminary study of the subject in Albany, I made a personal examination between July 19th and October 1st, of the different streams and their principal tributaries with an aggregate area of 5,783 square miles distributed as shown in the tables accompanying the descriptions of the several watersheds. These areas have been derived by planimeter from the best available data in each case, whenever possible from the topographical sheets of the United States Geological Survey, otherwise from the map of the Forest, Fish and Game Commission or from the Postal map of New York State. In the following studies the maps of the United States Geological Survey where they have been completed proved of the greatest assistance, but as they have not been completed for the major part of the territory a single aneroid barometer compared at the beginning and end of each series of observations with points of known elevation, was generally used to determine the rate of fall of the streams and the elevation and extent of storage basins. At some of the most important points, stadia profiles of the streams were run, showing more definitely the developed and undeveloped waterpower and giving fuller indications as to the extent of stillwaters and storage basins. Characteristic curves are available in this office for a study of the regulation in stream flow obtainable from the several storage basins considered. Where sufficient data was obtainable, curves, derived from a direct gaging of the flow of the individual streams themselves, have been used. Where this was not the case, by analogy and deduction from similar streams for which these curves have already been determined, a reasonable approximation of the resulting regulation has been obtained. Owing to the very general character of the study and the lack of complete data, the figures given are in the main very rough approximations; however, they are believed to be conservative as to storage and resultant benefits to power and liberal as to the amount of State land likely to be affected. They are believed to be ample for drawing general conclusions as to the storage and power possibilities of the several watersheds and for determining the points at which surveys should be made when the general policy for the particular stream is decided upon. It is to be specially noted that the tables of power capacities resulting from the several reservoirs contemplate the possibility of their being so regulated as to produce a certain minimum summer flow during what might be called an ordinary year. This would necessitate the retention of a large amount of storage in these reservoirs possibly through a term of years, during which time a considerable quantity of it would not be released during the dry months. As the power plants will probably have a certain amount of auxiliary power anyway to enable them to utilize the waterpower to its fullest extent, it will be feasible in a given instance by special study of the watershed and the power needs, to regulate the flow from its reservoir or reservoirs so as to strive for a somewhat higher minimum flow during many of the years, relying upon a greater use of auxiliary occasionally, or possibly an occasional cutting down of the output of the plant. For these reasons, the column entitled " Net 24 Hour H. P." does not represent the ultimate developable power to be obtained from the stream after regulation, which would be a considerably greater quantity in many cases. This condition is very clearly set forth in many power plants between Carthage and Dexter on the Black river, where the present development is as much as three times as great as that for which the ordinary summer low water flow would provide power. Of course no such excess will probably prove advantageous under regulated flow but it will still be considerable.

Storage possibilities aggregating approximately 38.7 billion cubic feet were located in the territory, distributed as shown in the accompanying table where is also shown the areas of the reservoirs and the amount and character of State land affected by them as nearly as has been practicable. The several projects vary in attractiveness as to benefits to be derived in proportion to the probable outlay, but they will all prove worthy of fuller and more definite study when the need for increased power in each particular watershed becomes sufficient. The immediate need and market for the increased power due to the several reservoirs varies greatly, being particularly great on the Black and Oswegatchie. However, there is every prospect that for all watersheds the demand is not far distant. It has been the experience in the past, notably at Niagara, that the existence of cheap and abundant continuous waterpower creates of itself a steady and increasing demand and market, especially for electro-chemical industries. Furthermore, there is an excellent opening for electric interurban railways, the construction of which would be encouraged by the growth of cheap water power as well as for general manufacturing enterprises.

As nearly all the reservoir sites noted in this reconnaissance have considerable fall from which power could be developed either at the dam site or immediately below them, it will prove desirable where such is the case to use the control afforded by them even when they are located on some tributary for producing uniform flow at the dam site and in all such cases I have considered them as so used in the following studies, and taken the increment to the ordinary mean minimum monthly flow as constant below that point.

It is probable that a number of these reservoirs will prove, upon further information and study, to be alternate schemes one to the other. Should borings and accurate surveys show that higher dams than are contemplated in this report could be built at reasonable cost at some of the sites noted, sufficient storage might be obtained to render some other reservoir unnecessary. In fact, surveys and more extended study will probably show that, for some at least of these reservoirs, it will be feasible by increasing the height of the dam to largely increase the storage capacity without very material increase in the extent of flowage, as in all cases the height of dam used in these studies has been taken only as high as appeared readily practicable from the incomplete data at hand.

STORAGE RESERVOIR SITES NOTED.

RESERVOIR.	Watershed.	Probable capacity.	Area of land to be flooded.	AREA OF STATE LAND TO BE FLOODED.			Remarks and State land totals.
				Wooded.	Treeless or swampy.	Already flooded most of year.	
In Adirondack Park.		*Billion Cu. Ft.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	
Moose river	Black river	6.3	4,636	1,400	2,600	....	On south branch Moose.
Beaver flow	Black river	3.0	6,030	630	2,200	3,200	On Beaver river.
Beaver lake	Black river	0.4	1,000	....	....	....	On Beaver river.
Cranberry lake	Oswegatchie	3.5	9,400	600	....	6,480	On East Branch.
Newton Falls	Oswegatchie	2.0	4,480	....	....	....	On East Branch.
Five-mile Stillwater	St. Regis river	1.8	1,600	....	....	....	On West Branch.
Grass river flow	Grass river	3.5	5,000	....	....	....	On South Branch.
Totals in Adirondack Park		20.5	32,146	2,630	4,800	9,680	17,010 acres.
Outside of Adirondack Park.							
Hawkinsville	Black river	3.3	2,365	33	....	....	On Main river.
Copenhagen	Black river	0.7	716	....	....	....	On Deer river.
Harrisville	Oswegatchie	1.3	1,700	....	....	....	On West Branch.
North Branch	Grass river	0.5	1,200	....	....	....	On North Branch.
Clare	Grass river	1.0	1,600	....	....	....	On Main and North Branch.
Sylvian Falls	St. Regis river	1.2	1,000	....	....	....	On West Branch.
St. Regis Falls	St. Regis river	1.5	1,440	....	....	....	On East Branch.
Santa Clara	St. Regis river	1.0	620	....	....	....	On East Branch.
Titusville	Salmon river, east	2.5	3,190	....	1,170	....	On Salmon (Franklin county).
Salmon Falls	Salmon river, west	5.2	4,370	....	....	....	On Salmon (Oswego county).
Total outside Adirondack Park		18.2	18,201	33	1,170	....	1,203 acres.
Total		38.7	50,747	2,663	5,970	9,680	

SALMON RIVER (OSWEGO CO.)

The Salmon river, with a drainage area at Pulaski of 264 square miles, rises among the mountains of Montague township at an elevation of 1900 feet above the sea. Thence it flows for fifty miles, first southerly and then westerly, through a country diversified by woods and cultivated lands, to Lake Ontario.

WATERSHED AREAS OF SALMON (OSWEGO CO.) RIVER BASIN.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated point.
	Feet.	*Sq. Miles.*
Salmon river at Pulaski	343	264
Salmon river at Salmon Falls	800	190

Because of the large extent of swampy lands at its source and because of the comparatively gentle slopes of the uplands, this river has a fairly well regulated natural flow amounting to an ordinary mean monthly minimum of .4 c. f. s. per square mile. Below the village of Redfield there is an extensive stillwater terminating in a deep rocky gorge three miles long, in which is situated the Salmon Falls. Through this gorge and the rapids below, terminating at Altmar, the river has a fall of 377 feet in six miles or at the rate of sixty-three feet per mile. From Altmar to the lake the fall of 274 feet is quite uniformly distributed at the rate of twenty-four feet per mile. The only storage basin suitable for power regulation was found in the stillwater at Redfield. A dam, fifty-three feet high with crest at elevation 950 and of moderate length, founded on rock, at the end of the stillwater and above Salmon Falls, together with three low barriers or dikes, one near the lower end of the proposed reservoir cutting off a narrow lateral valley, and two to the south of the village of Redfield where some low, marshy ground would otherwise admit the impounded water into the catchment area of the Mad river, would flood 4370 acres at elevation 950 or 3.3 per cent. of the area of the watershed above the dam, and would afford 5.2 billion cubic feet of storage, or

27,000,000 cubic feet per square mile at the dam site where the drainage area is 190.5 square miles. None of the land flooded by this reservoir is State land. This project was considered by the Deep Waterways Commission and a reservoir site of substantially the same capacity was noted. The land flooded for this storage is partly composed of cultivated, but not valuable, farm land and the swamp and timber areas contain timber of little value. The small hamlet of Redfield would be submerged and not more than ten miles of highway would have to be relocated. Such storage if regulated for uniform flow at the proposed dam will increase the ordinary minimum mean monthly flow at that point from 75 c. f. s. to 564 c. f. s. and at Pulaski from 105 c. f. s. to 593 c. f. s. The stream gaging for this river, which is located at Pulaski, only covers a little over two years of time, and as the above figures are based on the mass and characteristic curves derived from these short term records, they are subject to revision when longer term records become available. However, as the stream has considerable natural regulation and quite steady flow, the correction on this account will not be as great as it would be in some other streams. There is one notable opportunity for power development on this river, namely, at the gorge just below the proposed dam where a pipe line not more than two miles long would convey the regulated flow from the reservoir to the foot of the rocky gorge and there develop power under a mean head of 265 feet. The Oswego Light & Power Company has already been formed for developing power at this point by the construction of a somewhat lower dam and the utilization of an alleged head of 300 feet. Work on this development has not yet been begun. The storage contemplated by them being slightly less than for our project outlined above, the resulting regulation of flow would be consequently somewhat less. Below this power possibility with 265 feet head, the river has a fall of 140 feet in about three miles which could be developed as a separate proposition or made a part of our first project, so that with a pipe line not more than five miles long 405 feet of head could be developed near Altmar instead of 265 feet at the foot of the rock gorge. More extended study and more complete data would be necessary to determine whether this should be developed as a separate proposition or not. The indications are, however, that the higher head is the best solution of the problem.

From a personal examination, I consider that below the 405 feet development just outlined there is a total of at least seventy feet of undeveloped head divided among several sites which it would be feasible to develop if the flow of the stream was regulated to the extent of the storage above mentioned. The river channel below Altmar has rock bottom and steep sides at many places, affording opportunities for the development of cheap power under from twenty to forty feet head. At Pulaski there is now being utilized thirty-two feet of head. Herewith I submit a table showing power already developed or capable of development with regulated and unregulated flows. These figures are based on limited data as to stream flow and are subject to revision when more extended records of run-off shall be available.

ESTIMATE OF AVAILABLE POWER ON SALMON (OSWEGO COUNTY) RIVER.

For natural flow and for regulated flow due to 5.2 billion cubic feet of storage in reservoir at Redfield according to short term stream gagings at Pulaski.

(7-day, 24-hour net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 5.2 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H.P.*	*Sec. Ft.*	*Net H.P.*	*Sec. Ft.*	*Net H.P.*
WATER POWER FULLY OR PARTLY DEVELOPED									
Pulaski	264	40	32	½	366	106	290	594	1,635
WATER POWER UNDEVELOPED									
Altmar to Lake Ontario	....	40	70	....	....	106	640	594	3,580
From reservoir	190	42	405	5	....	76	2,650	564	19,600
	....	....	507	....	366	....	3,580	....	24,815

NOTE.—Flow from reservoir regulated to produce uniform flow from same.

The case of the Oswego County Light & Power Company shows the importance for the State, in case the policy of development of the water powers of the State under State ownership or control is determined upon, of prompt action to prevent its valuable power possibilities being developed by private corporations. With the reservoir built as above outlined, it would be possible to sell the regulation from this reservoir to the power users at Pulaski and to the Oswego County Light & Power Company, under restrictions as to control, advantageous to the public, and at figures which should producė a revenue adequate for sinking, depreciation, and maintenance funds, leaving the undeveloped sites from Altmar to Pulaski for the development of power under State ownership as well as control. An alternative plan would be for the State to construct not only the reservoir but also the necessary pipe line and power plant for developing the full 405 feet head, and to sell the power either at the generating station or else to the various municipalities within reasonable transmission distance. In case the development under 405 feet head were decided upon, there would be 19,700 continuous 7-day, 24-hour horsepower available at the turbine shaft, with 80 per cent. efficiency and 95 per cent. of head considered as utilized. With 40 per cent. load factor this becomes 49,000 horsepower for sale. The market for this power would be quite good with Syracuse, Rome and possibly Watertown, within easy transmission distance, that is, between thirty and forty miles.

Ordinarily a reconnaissance would not furnish data sufficient to form any trustworthy estimate of cost for such a project as that at Redfield. Fortunately, however, the Deep Waterways Commission made a careful estimate of costs for a similar reservoir in 1900 which enables us to make a fair approximate preliminary estimate for our project. The dam considered by them was three feet higher than the one contemplated in this report because they had in view the regulation of flow of the river beyond what would probably be economical for power development. Revising their figures so as to allow for a decrease in the height of the dam, a more general use of concrete in the construction and some changes in unit prices due to change in commercial conditions since their report was issued, yields as a very liberal figure $1,350,000 as the probable cost for this storage, including land damages and a liberal allowance for contingencies. This would make the storage cost at the rate of $260 per million cubic feet of storage. This is higher than has been found to be necessary for some of the Adirondack storage but when we consider the cost per horsepower created on the stream below by the regulation of flow, it shows the project to be probably attractive financially. According to the table submitted herewith, 24,815 continuous 24-hour, 7-day horsepower would be rendered available, or at the rate of $54 per horsepower for storage. Mr. Freeman, in his report of 1908, takes as a minimum tax for water for power development from the Sacandaga project $10 per annum per horsepower, which would yield a return of $248,000 per annum upon the above investment, which is so largely in excess of any sinking fund and interest, depreciation, and maintenance charges as to indicate thoroughly the financial feasibility of the undertaking, even though the value of power should be very much less than on the Hudson. Furthermore, assuming $50 per horsepower, which I consider very liberal, as the probable cost of pipe lines, hydraulic and electrical machinery, and buildings, gives as the cost of development alone on the above 49,000 horsepower, $2,450,000, or for the entire project including storage producing 49,000 10-hour horsepower, $3,800,000, or at the rate of $77 per horsepower. From the above it is safe to assume that should a ready market for the power exist, as seems probable, such a plant would be sufficiently profitable to readily provide sinking and depreciation funds as well as maintenance. In addition the sites below Altmar would also be made available for development with regulated flow and the increase in the value of these sites would still further add to the benefits to be derived from this project.

RECOMMENDATIONS.

This project on the Salmon river appears to be a very promising one and worthy of more detailed consideration than has been possible in this reconnaissance. For a complete presentation of this project, an accurate survey should be made at the dam and power site to enable tentative plans to be drawn, from which an accurate and detailed preliminary estimate of cost could be made. While the estimate for the dam proposed by the Deep Waterways Commission is available, they have shown in their report no plans upon which this estimate was based. Consequently the estimate given above can be taken as reliable only as placing a probable maximum limit to the cost. As far as the power project is concerned, there are no surveys or plans other than can be obtained from the topographical sheets of the United States Geological Survey.

BLACK RIVER.

The Black river, with a drainage area of 1,930 square miles at its mouth, rises among the lakes and mountains in the southern part of Herkimer county, at an elevation of about 2,000 feet above the sea. It first flows in a southwesterly direction twenty-eight miles to the State dam at Forestport, thence in a northwesterly direction forty-eight miles to Carthage and finally in a westerly direction twenty-eight miles to its mouth in Black River bay.

The eastern, or very much the larger portion of its watershed, lies among the Adirondacks where the natural precipitation is in excess of fifty-five inches over a large part of the area, and where the streams are fed from numerous springs and lakes which tend to produce a naturally uniform flow and large runoff. This natural uniformity is further increased by some regulation due to a limited amount of storage at Beaver Flow and Fulton Chain lakes. Although extensive marshes are not so numerous as in other parts of the Adirondacks, rendering storage more expensive because of the greater height of the dam necessary for storage in adequate volume, and although sites for large storage projects are very scarce, yet the rapid and very considerable fall of the streams as they leave the hill country to join the Black river, affording abundant possibilities for power development, together with the large amount of power already developed on Black river, which would be benefited by storage on these tributary streams, render such storage as may be obtainable particularly valuable.

The western portion of the watershed lies among the mountains between the Black river and Lake Ontario, where the slopes are not so precipitious as in the Adirondacks, and where the land at the headwaters is either uncultivated or still in forest. There is considerable marshy territory but only at the extreme headwaters of the streams where no considerable catchment area is available. These conditions render the opportunities for power not so great as on the eastern tributaries, and reservoir sites of suitable capacity and drainage area for regulation almost entirely wanting. The water power possibilities of Black river proper have been already very completely developed up to and beyond the ordinary minimum unregulated flow, making it the largest producer of power of any of the streams in the State with the exception of the Hudson. In addition to the plants on the main stream many of the sites on the tributaries have of late years begun to be utilized. There is now, therefore, in the Black river system an extensive power industry, which having utilized the sites on the main river, is extending into the tributaries in search for further power to meet the needs of the industries of the region. Notwithstanding the natural advantages which the Black river system has, tending to produce a more uniform flow than in many of the other streams in the State, it is one of the heaviest sufferers from lack of ample water power during the summer months, because the present developments have of necessity been pushed to the utmost and even beyond the low water capacity of the stream. They are forced each year to run for a considerable portion of their time either with auxiliary steampower or at very reduced output. The accompanying profile shows the extent to which those industries, lying between Black River bay and Lyons Falls, and up the Moose river to McKeevers, are thus crippled, and also the extent of relief which would be furnished by the construction of the proposed reservoir on the south branch of the Moose. The mean monthly flow of the Black river between Carthage and Watertown falls quite frequently as low as 794 c. f. s., or at the rate of 42 c. f. s. per square mile of drainage and for short periods it falls even much lower. However, this 794 c. f. s. is taken as the ordinary mean minimum monthly flow in our computations as to the increase in power to be derived from the proposed storage. The principal tributaries of the Black river are the Moose, Beaver, Deer, Independence and Sugar rivers. The accompanying table shows the relative importance of the various tributaries and the drainage areas of the streams at such points as have been used in our computations.

WATERSHED AREAS OF BLACK RIVER BASIN DERIVED FROM MAPS OF THE U. S. GEOLOGICAL SURVEY AND THE FOREST, FISH AND GAME COMMISSION, AND THE POSTAL MAP OF NEW YORK STATE.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated point.
	Feet.	*Sq. miles.*
Black river at mouth	247	1,930
Black river at Huntingville	498	1,889
Black river at crest of Lyons Falls	802	879
Black river above junction of Moose	802	463
Black river at Hawkinsville	945	315
Black river at Forestport	1,120	268
Moose river at Lyons Falls	802	416
Moose river at Moose River village	....	346
Moose river at mouth of Red river	1,800	116
Beaver river at Castorland	726	338
Beaver river at Tisses Falls near Croghan	....	274
Beaver river at No. 4	....	215
Beaver river at Beaver Flow	....	165
Deer river at mouth	726	102
Deer river at Copenhagen	1,163	84
Independence river at mouth	730	99
Sugar river at mouth	918	68
Otter creek at mouth	730	65

The main stream above the mouth of the Moose at Lyons Falls has a drainage area of 463 square miles. At Forestport, where the drainage area is 268 square miles, there is a large reservoir in which water is collected and from which it is distributed during the navigation season through a feeder to the Black and Erie canals at Boonville. In addition to the Forestport reservoir there are numerous lakes and artificial ponds near the headwaters of the various branches of the river which store water during the wet season of the year and from which the Forestport reservoir is fed. The law under which this diversion of water for canal purposes at Forestport is carried on requires that of the 16,000 cubic feet per minute which is delivered to the feeder, 5,000 cubic feet per minute shall be returned to the Black River canal at Boonville, and thence to the Black river at Lyons Falls, and that the remaining portion of the 16,000 cubic feet per minute less evaporation and seepage shall be passed on to the Erie canal. In consequence of this diversion very little water passes down the Black river from the Forestport dam during the summer months. The total storage for canal purposes above and including the Forestport reservoir amounts to about 2,000,000,000 cubic feet, or at the rate of 7.5 million cubic feet per square mile, according to Rafter's Hydrology, which is far from the limit of storage capacity for the drainage area at that point. A large storage basin was noted on the Main river just below Forestport, terminating in a promising site for a high masonry dam just below Hawkinsville. At that point a dam about 110 feet high founded on rock, and of moderate length, could be built, probably, at a reasonable cost, impounding 3.3 billion cubic feet of water, of which 3.2 billion cubic feet would be available for regulation with 60 feet depletion of reservoir. Two thousand three hundred and sixty-five acres of land, mostly low and uncultivated, covered with bushes and a small amount of second growth of timber would be flooded. The land for this reservoir is entirely outside of the limits of the Adirondack park and only about thirty-three acres of the area is owned by the State. Because of the considerable power which could be developed at the dam site, it will probably prove to be the most economical disposition of this storage to use it for producing a uniform flow from the reservoir at the dam. A study of the regulation to be obtained from the reservoir is very much complicated by the existence of the other storage reservoirs farther up the valley, and the consequent draft of 250 c. f. s. through the Forestport feeder. I have assumed that the characteristic curve for the Black river at this point will lie half way between that for the Black river at Carthage and that for the East Canada creek at Dolgeville. The total storage above and including the Hawkinsville reservoir would amount, should that reservoir be built, to 5.2 billion cubic feet. The drainage area is 315 square miles, giving a storage of 16.5 million cubic feet per square mile. This storage is so well within the capacity of the watershed, that there will be no difficulty in filling the Hawkinsville reservoir promptly in spite of the draft through the canal feeder. The regulated flow at the Hawkinsville dam would, according to our characteristic curves with the above storage, amount to 1.45 c. f. s. per square mile, or a total of 457 c. f. s.; deducting 250 c. f. s. drawn by the canal feeder, leaves 207 c. f. s. continuous 7-day, 24-hour regulated flow for power purposes at Hawkinsville. While there are no stream records available from which a close estimate of the unregulated flow at Hawkinsville at the present time can be made, I should place the ordinary minimum at about 59 c. f. s. This would give a constant increment to the low water flow in the Black river from Hawkinsville to the mouth, of 148 c. f. s. continuous 7-day, 24-hour flow, and this quantity has been used in the accompanying table showing the power available with and without regulation from the Hawkinsville reservoir. In addition to the increased regulated flow for all the plants from Hawkinsville to Dexter at the entrance to Black River bay, there would be created a power at the site of the dam itself where a mean head of 128 feet would be available with not more than three-quarters of a mile of pipe line. The figures of this table are based on a deduced stream flow at Hawkinsville and are subject to revision when actual records of run-off at that point are available.

ESTIMATES OF AVAILABLE POWER ON BLACK RIVER.

For Natural and for Regulated flow due to 3.2 bil. cu. ft. of storage in reservoir at Hawkinsville for long term conditions assuming character of flow a mean between Black River at Carthage and the East Canada Creek.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 3.2 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P*
WATER POWER FULLY OR PARTLY DEVELOPED:									
Hawkinsville	315	50	22	....	300	59	110	207	384
Port Leyden	....	50	34	....	425	179	525	336	979
Lyons Falls	463	50	65	....	4,600	423	2,360	580	3,245
Carthage	1,812	44	41.9	....	8,151	794	2,865	951	3,420
Herring's Dam	....	44	18	....	5,210	794	1,230	951	1,468
Deferiet	....	....	45	....	9,500	794	3,070	951	3,670
Great Bend	....	....	25.7	....	2,514	794	1,755	951	2,100
Felts	....	....	13	....	3,020	794	890	951	1,060
Black	....	....	31.7	....	3,311	794	2,160	951	2,595
Huntingtonville	....	....	18	....	1,396	794	1,230	951	1,468
Marble Co. Dam	....	....	8	....	....	794	545	951	654
Watertown	....	43	66.5	....	12,777	794	4,545	951	5,506
Below Taggerts dam	1,930	....	12	....	....	794	820	951	984
Glen Park	....	....	56	....	8,538	794	3,820	951	4,575
Brownville	....	....	49.5	....	10,363	794	3,380	951	4,045
Dexter	1,930	42	12.9	....	2,428	794	880	951	1,055
Carthage* to Dexter	....	....	17.8	....	....	794	1,220	951	1,460
	....	....	537	....	72,533	....	31,405	....	38,668
WATER POWER UNDEVELOPED:									
Hawkinsville	315	50	128	¾	3	59	....	207	2,280
	....	....	665	....	72,536	....	31,405	....	40,948

NOTE.—Flow from reservoir regulated to produce uniform flow from same.
*Total of the fractional heads at the various plants not utilized under present conditions.

The Moose river, the most important tributary of the Black, has a drainage area of 416 square miles at its mouth. This stream rises in Hamilton county in the heart of the Adirondacks, where the annual precipitation is in excess of fifty-five inches. Its watershed contains an unusually large area covered with timber of very considerable growth, together with extensive swamps. In consequence of the above conditions the run-off is very large, and because of them and because of some regulation obtained from some storage in the Fulton Chain lakes, the minimum monthly flow per square mile amounts to 0.6 c. f. s. Stream gage records at Moose river are available for four years, with the exception of some of the winter months. A study of these records shows a distinct relation as to rainfall and run-off between this river and West Canada creek, whose headwaters lie contiguous to it. Consequently by analogy and deduction it has been possible to interpolate the missing records of winter flow for the Moose river. From the record thus completed, which shows the average run-off as 80 per cent. of the precipitation, as shown by the rain gages, mass and characteristic curves for the Moose river were derived, which, it is believed, furnish a reasonable approximation for the following preliminary studies. The high percentage of run-off to rainfall is due to the fact that the rain gage stations, located as they are in the valleys, in accessible places, do not furnish a true mean for the watershed, as they do not take into account the greater precipitation upon the mountain ranges. The most promising reservoir site in the Black river watershed was noted at a place called the Plains on the south branch of the Moose. An excellent site for a high masonry dam was found about one-quarter of a mile below the mouth of the Red river, where the Moose flows over a rock bottom through a narrow rock gorge. Here a short masonry dam ninety feet high with a low dike to the south on the other side of the hill, will flood 4,636 acres of land all within the Adirondack Park. Of this flowage 4,000 acres are owned by the State and are a part of the Adirondack Forest Preserve. However, at least 2,600 acres of this State land consists of swamps or plains devoid of forest or useful vegetation; in fact, is unsuited for forest growth and has had no forest on it since before the days the country was first settled. Not more than 1,400 acres of this State land contains forest growth of pine at a place called the Pineries. The capacity of this reservoir will be 6.2 billion cubic feet, of which 6.1 billion cubic feet would be available for regulation, with a depletion of sixty feet. Between the crest of this dam and the mouth of the Moose river, at Lyons Falls, there is a fall of 1,080 feet. A large part of this is concentrated between McKeever, where there is an existing power plant, and Lyons Falls, nearly all of which is either already developed or capable of comparatively easy development. Above McKeever, there is a possibility for the development of power under 100 feet head near Limekiln Falls by means of one mile of canal and pipe line, utilizing Green lake as a forebay. In addition, there is a power possibility for development under fifty feet head at the dam itself. It will prove desirable to regulate the flow from this reservoir so as to produce a uniform minimum flow at Moose river, where the area of the watershed is 346 square miles for the immediate benefit to the existing plants and possibilities between McKeever and Lyons Falls. The area of the watershed at the reservoir site is 116 square miles which should insure a prompt filling up of the reservoir after depletion, especially taking into account the high annual precipitation at this point. The mean monthly flow of the stream at Moose river would be increased by the above regulation from 208 c. f. s. to 702 c. f. s. This increase in flow amounting to 494 c. f. s. would be available not only for the developed and undeveloped power sites between McKeevers and Lyons Falls, but would also be added as a constant increase to the flow of the Black river between Lyons' Falls and its mouth, affording increased power to all the plants between those points. A very large proportion of this increase could be utilized at once by the plants without the addition of a single wheel, thereby preventing either the reduction of their output during the summer months, or else saving the coal bill necessary for the auxiliary power which has to be used at present. All of these advantages are shown more in detail in the accompanying table:

ESTIMATE OF AVAILABLE POWER ON BLACK AND MOOSE RIVERS.

For Natural and for Regulated flow due to 6.1 billion cu. ft. of storage in reservoir at the Plains on the South Branch of Moose River with 60 ft. depletion as computed from short term records with winter flow interpolated by analogy from West Canada Creek.

(7-day, 24-hour net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 6.1 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED:									
McKeever	346	50	22	....	2,630	208	395	702	1,330
Lyonsdale	....	....	35	....	2,100	244	735	738	2,225
Agers dam	....	....	24	....	110	244	500	738	1,525
Shuetown	....	....	28	....	600	244	590	738	1,780
Kosterville	....	....	60	....	2,796	244	1,260	738	3,810
Goulds Mill	416	....	44	....	2,500	244	925	738	2,800
Lyons Falls	879	50	65	....	4,600	447	2,500	941	5,260
Carthage	1,822	44	41.9	....	8,151	794	2,865	1,288	4,655
Herring's dam	....	....	18	....	5,210	794	1,230	1,288	2,000
Deferiet	....	....	45	....	9,500	794	3,070	1,288	5,000
Great Bend	....	....	25.7	....	2,514	794	1,755	1,288	2,855
Felts Mills	....	....	13	....	3,020	794	890	1,288	1,445
Black river	....	....	31.7	....	4,068	794	2,160	1,288	3,520
Huntingtonville	....	....	18	....	1,396	794	1,230	1,288	2,000
Marble Co. dam	....	....	8	....	....	794	545	1,288	890
Watertown	....	43	66.5	....	12,777	794	4,545	1,288	7,380
Below Taggarts dam	....	....	12	....	....	794	820	1,288	1,330
Glen Park	....	....	56	....	8,538	794	3,820	1,288	6,210

Brownsville	....	....	49.5	....	10,363	794	3,380	1,288	5,490
*Dexter	1,930	42	12.9	....	2,428	794	880	1,288	1,430
Carthage to Dexter	....	....	17.8	....	....	794	1,220	1,288	1,980
	....	....	694	....	83,301	....	35,315	....	64,915
WATER POWER UNDEVELOPED:									
" Plains " reservoir site	116	50	50	....	....	....	....	235	1,015
Limekiln Falls	....	....	100	9/10	....	....	....	235	2,020
Moose river to Fowlerville	346	....	112	1¼	....	208	2,000	702	6,780
Fowlerville	....	....	75	1	....	208	1,340	702	4,540
Fowlerville to Lyonsdale	....	....	30	¼	....	244	630	738	1,905
Shuetown	416	50	32	¼	....	244	670	738	2,035
	....	....	399	....	....	....	4,640	....	18,295
	....	....	1,093	....	83,301	....	39,955	....	83,210

NOTE.—Flow from reservoir regulated to produce uniform flow at Moose River village.

* Total of the fractional heads of the various plants not utilized under present conditions.

The figures of this table are based on incomplete run-off records at Moose river village and are subject to revision when records at that point for the entire year including winter months are available. The only other noteworthy site for storage on the Moose was noted on the north branch at Nelson lake, where perhaps as much as 1,000,000,000 cubic feet of water might be stored. However, this site was not considered worthy of more than passing mention at the present time. The Moose river reservoir at the " Plains," lying as it does in the heart of the Adirondacks, with nothing more than a few scattered camps on its entire watershed, presents a wonderful opportunity for the collection of pure water for domestic purposes. Its elevation above the sea (1,880 feet), is so great as to make it available at some future time as a source of gravity water supply for any or all cities which may be within reach, and ultimately it is likely to become very valuable for such purposes. What would be a large amount of water for this purpose, would have no appreciable influence on its use for water power storage, the quantity being relatively so small. In addition to the benefits to be derived from this rservoir in increased water power there will be another immediate indirect benefit in its effect on the conditions at the Fulton Chain lakes. With the Moose river reservoir in operation it will not be necessary to draw upon the Fulton Chain until late in the season, possibly not until after the 1st of October, whereas at the present time considerable water is drawn from them early in the season in an effort to provide the water powers at and below Lyons Falls with a sufficient flow of water. The " Chain lakes " are surrounded by camps and summer resorts and this lowering of the lake levels during the summer season is a source of contention between the summer colony and the power owners.

The next tributary of the Black river in importance for power and storage is the Beaver river with a drainage area of 322 square miles at its mouth near Castorland. This river rises in Lake Lila, in the extreme northern part of Hamilton county, at an elevation of 1,714 feet above the sea. The river flows thence with a moderate declivity through a swampy territory to Beaver Flow, where there is situated a concrete dam built by the State, which flows in the neighborhood of 3,200 acres of land originally swamp. This flow or reservoir was constructed by the State as compensation to the power owners on Black river for conversion of water for canal purposes at Forestport. The flow from this reservoir is now regulated to equalize as far as possible the flow of the Black river between Carthage and Dexter. The crest of the dam is at elevation 1,658 feet above the sea. After leaving the Beaver flow, the river passes through a series of precipitous drops and rapids to Beaver lake, the elevation of whose water surface is 1,436 feet above the sea. From Beaver lake to Carthage Electric Light plant just above Belfort, the river has a fall of about 360 feet. In this stretch there are two noteworthy falls, namely, Eagle and High Falls. At Eagle Falls there is a precipitous drop with some rapids from which at least seventy-five feet head for power could be obtained by means of dam and pipe line. At High Falls the possibility is somewhat less, being however, at least fifty feet. At Belfort there are two considerable power plants already in operation, one furnishing electricity for Carthage, the other for Lowville. Between Belfort and Croghan there is a notable opportunity for power under at least seventy feet head. This site is known as Tisses, or Baslins Falls. At Croghan and at Beaver Falls there are several plants in operation utilizing most of the head obtainable. From the United States Geological Survey stream gage records a mass curve has been drawn for this river at Croghan. This curve extends over about two years, but by analogy and deduction from the Hudson flow at Mechanicville a long term characteristic curve has been worked out for this river and the results have been used in the power computations. Only one opportunity for anything like an adequate regulation of the flow of this river was noted. This is at Beaver Flow, where by strengthening and heightening the present masonry dam and putting in flash gates on its crest, and thus raising the surface of the water twelve feet above the present crest of the dam, approximately 3,000,000,000 cubic feet of storage would be obtained. These gates could be so operated that at a time of extreme flood they would be opened and the level of the lake would be maintained at the same flood level which it has at the present time. By this means there would be no need of taking into account any flooding due to high water, as the level of the lake would be maintained at a constant maximum, namely, the crest of the dam. Not more than 2,830 acres of land in addition to that already under water would be thus flooded, all State land within the Adirondack Park. Of the 2,830 acres, the larger part is already treeless or swampy, and not more than 630 acres, which lies on steep hillsides along the shore of the present flow, contain timber of any value, and much of this is already flooded frequently by high water with considerable damage to forest growth. By still further increasing the height of the dam very much larger storage could be obtained. The area of the watershed at this point is 215 square miles which would warrant greater storage capacity. If upon further study and examination they should prove feasible, from a general examination of the site, I should say that this increased storage could be obtained without any material increase in the amount of State land needed, but, however, would probably necessitate some relocation of the line of the Adirondack division of the New York Central Railroad between Beaver river and Brandreth Station. At Beaver lake, or No. 4, by building a low dam six feet high at its outlet, about 1,000 acres of swamp land could be flooded. This land is at present flooded at high water which is about six feet above the present normal level of the lake. Thus six feet of storage, amounting to approximately 0.4 billion cubic feet, could be obtained without flooding any land that is not already flooded at times of high water. By increasing the height of dam at the outlet of the lake, this storage could be very largely increased. It is impossible to say to what extent additional land would be flooded without a topographical survey, but I should say without doubt the increase to the flooded land would be very small in comparison to the increase in storage, as the first six feet of flooding would cover most of the low swamp ground about the shores of the lake. It will hardly prove desirable to build both of these reservoirs provided either one of them is constructed so as to come reasonably close to the capacity of the watershed at this point. However, it will prove desirable in case all the storage needed cannot be obtained at Beaver Flow to also supplement it by such storage as is available at Beaver lake. The most effective regulation from this storage is to be found in regulation for a uniform minimum flow at the outlet to Beaver lake where the drainage area is 225 square miles, thereby producing an encroachment to the flow of the river, which will remain constant throughout the course of the Beaver river, and be added to the minimum flow of the Black river in Castorland and Dexter. In addition to the more important falls and undeveloped sites for power on the Beaver river, there are several points where minor opportunities occur for development under small head, which at present would not be sufficiently attractive to attempt development, but which, with regulated flow, are likely to be ultimately developed as small projects. By means of the above, 3.4 billion cubic feet per second of storage, 245 cubic feet per second will be added to the minimum flow of the stream. The accompanying table shows the results of our study of the effect of this flow upon existing power plants and possible power sites. The figures of this table have necessarily been based on incomplete data as to reservoir capacities and as to the amount of available head at undeveloped sites, and are subject to revision when fuller data has been obtained.

ESTIMATE OF AVAILABLE POWER ON BLACK AND BEAVER RIVERS.

For Natural and for Regulated flow due to 3.4 billion cubic feet of storage in reservoirs at Beaver Flow and Beaver Lake for long term conditions deduced from short term records by comparison with the Hudson at Mechanicville — depletion as at present.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 3.4 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H.P.*	*Sec. Ft.*	*Net H.P.*	*Sec. Ft.*	*Net H.P.*
WATER POWER FULLY OR PARTLY DEVELOPED.									
Effley Falls	245	48	52	....	1,245	128	570	373	1,675
Belfort	264	47	47	....	1,440	138	550	383	1,550
Croghan	294	47	8.4	....	310	152	110	397	288
Beaver Falls	321	46	48	....	1,945	166	680	411	1,700
Carthage	1,822	44	41.9	....	8,151	794	2,865	1,040	3,765
Herring's dam	....	....	18	....	5,210	794	1,230	1,040	1,640
Deferiet	....	....	45	....	9,500	794	3,070	1,040	4,050
Great Bend	....	....	25.7	....	2,514	794	1,755	1,040	2,308
Felts Mills	....	....	13	....	3,020	794	890	1,040	1,167
Black river	1,889	....	31.7	....	4,068	794	2,160	1,040	2,845
Huntingtonville	....	....	18	....	1,396	794	1,230	1,040	1,615
Marble Co. dam	1,889	....	8	....	....	794	545	1,040	718
Watertown	....	43	66.5	....	12,777	794	4,545	1,040	5,965
Below Taggarts dam	1,889	....	12	....	....	794	820	1,040	1,075
Glen Park	....	....	56	....	8,538	794	3,820	1,040	5,000
Brownville	....	....	49.5	....	10,363	794	3,380	1,040	4,450
Dexter	1,930	42	12.9	....	2,428	794	880	1,040	1,160
Carthage to Dexter*	1,889	....	17.8	....	....	794	1,220	1,040	1,595
	....	....	571.4	....	72,905	....	30,320	....	42,566

WATER POWER UNDEVELOPED:									
Eagle Falls	225	48	75	[illegible]	....	117	750	362	2,340
High Falls	235	48	50	[illegible]	....	122	510	367	1,580
Tisses Falls	274	47	70	[illegible]	....	142	950	387	2,340
Beaver Falls	321	46	16	....	....	166	230	411	569
	....	....	211	....	....	....	2,440	....	6,829
	....	....	782.4	....	72,905	....	32,760	....	49,395

NOTE.—Flow from reservoirs regulated to produce uniform flow from Beaver river.

* Total of fractional heads at the various plants not utilized under present conditions.

On the Deer river, which has a drainage area of 102 square miles at the point where it flows into the Black river, only one feasible storage site was noted. This is at Copenhagen, where there is a flat basin consisting of cultivated land, 716 acres in extent. This land is all cultivated but contains very few houses. To the east of this flat there is a long, low ridge forming a natural dam. By constructing a masonry dam across the river channel just above the bridge at Copenhagen, utilizing this natural dam, seven-tenths billion cubic feet of storage would be formed. Immediately below the site of the dam there is a vertical natural falls where a plant is in process of construction at the present time to develop the power under 180 feet head. Farther down the stream at Kings Falls there is a power possibility with 100 feet head. There are no stream gauge records for the Deer river, but taking into account the rainfall and general configuration of the watershed, it showed greater similarity to the East Canada creek than any other stream of which we have record. Therefore, in the study of regulation to be obtained from this reservoir, the characteristic curve of the East Canada creek at Dolgeville has been used. From this it would appear that the minimum average monthly flow in ordinary years would be increased by regulation from 25 cubic feet per second to 110 cubic feet per second, the storage being regulated for constant flow from the dam. Below that point and on the Black river from Carthage to Dexter this increase of 85 cubic feet per second would be added as a constant increment to the minimum average monthly flow. The dam necessary for producing this storage will be quite lengthy and expensive, and the land flooded of considerable farming value; these conditions make this reservoir much less attractive than any of the others noted in the Black river watershed. On the other hand, however, water impounded at this point would have possible value not only for power regulation but also as a source of municipal supply for domestic purposes. In fact, Watertown is said to have considered this stream as a possible source of water supply at the time when they installed their filtration plant, taking water from the Black river. It is quite possible that the towns of Carthage, Lowville and possibly Watertown might find this an attractive source of water supply if a portion of the expense were borne by those benefited by power regulation. The accompanying table shows in detail the effect of this storage on stream flow and power output on the Deer and Black rivers. The figures of this table are based on a deduced stream flow for the Deer river and are subject to revision when actual records of run-off for this river are available.

ESTIMATE OF AVAILABLE POWER ON BLACK AND DEER RIVERS.

For natural and for regulated flow due to 0.7 bil. cu. ft. of storage in reservoir at Copenhagen for long term conditions assuming character of run-off the same as for East canada creek at Dolgeville.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent. efficiency).

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 0.7 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED:									
Copenhagen	100	39	18	....	155	25	39	110	170
Deer river	102	39	23	....	65	25	50	110	218
Carthage	1,822	44	41.9	....	8,151	794	2,865	879	3,190
Herring's dam	....	....	18	....	5,210	794	1,230	879	1,360
Deferiet	....	....	45	....	9,500	794	3,070	879	3,410
Great Bend	....	....	25.7	....	2,514	794	1,755	879	1,950
Felts Mills	....	....	13	....	3,020	794	890	879	985
Black river	....	....	31.7	....	4,068	794	2,160	879	2,400
Huntingtonville	....	....	18	....	1,396	794	1,230	879	1,365
Marble Co. dam	....	....	8	....	....	794	545	879	605
Watertown	....	43	66.5	....	12,777	794	4,545	879	5,025
*Taggarts dam	....	....	12	....	....	794	820	879	910
Glen Park	....	....	56	....	8,538	794	3,820	879	4,235
Brownsville	....	....	49.5	....	10,363	794	3,380	879	3,745
*Carthage to Dexter	....	....	17.8	....	....	794	1,220	879	1,345
Dexter	....	42	12.9	....	2,428	794	880	879	975
	....	....	457	....	68,185	....	28,499	....	31,888

* Total of the fractional heads at the various plants not utilized under present conditions.

WATER POWER UNDEVELOPED.									
High Falls	100	39	180	....	....	25	390	110	1,710
King Falls	100	39	100	½	....	25	215	110	950
	....	....	280	....	68,185	....	605	....	2,660
	....	....	737	....	....	....	29,104	....	34,548

NOTE.—Flow from reservoir regulated to produce uniform flow from same.

ESTIMATE OF AVAILABLE POWER ON BLACK RIVER BETWEEN CARTHAGE AND DEXTER.

For natural and for regulated flow due to 13.4 bil. cu. ft. of storage in Beaver Flow, Beaver Lake, Moose, Hawkinsville and Copenhagen reservoirs.

(7-day, 24-hour net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Average gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 13.4 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net. H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED.									
Carthage	1,822	44	10.9		1,136	794	745	1.776	1,675
Carthage			31		7,015		2.120		4,760
Herrings' dam			18		5,210		1,230		2,778
Deferiet			45		9,500		3,070		6,920
Great Bend			16.7		1,114		1,140		2,570
Great Bend			9		1,400		615		1,378
Felts Mills			13		3,020		890		2,082
Black river			12.7		757		870		1,940
Black river			19		3,311		1.290		2,930
Watertown water works			18		1,396		1,230		2,758
Marble company dam			8				545		1,232
Watertown		43	27.9		5,790		1,810		4,330
Knowlton's dam			16.1		3,583		1,100		2,459
Herricks dam			10.7		1,073		730		1,645
Taggarts dam			11.8		2,331		805		1,807
Below Taggarts dam			12				820		1,839
Glen Park			22		3,528		1,500		3,375

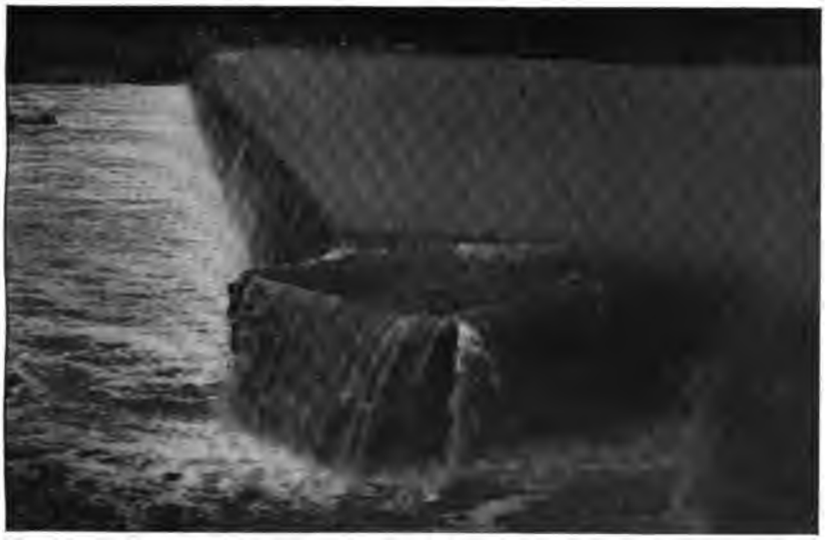
Glen Park	....	....	34	....	5,010	....	2,320	....	5,185
Brownville	....	....	30	....	3,304	....	2,050	....	4,600
Brownville	....	....	19.5	....	7,059	....	1,330	....	2,960
Dexter	....	42	12.9	....	2,428	....	880	....	1,980
Carthage to Dexter*	....	....	17.8	....	....	....	1,220	....	2,680
	....	....	417	....	68,065	....	28,410	....	63,883

NOTE.— Flow from each reservoir regulated to produce uniform flow from it.

* Total of fractional heads at the various plants not utilized under present conditions.

The 13.4 billion cubic feet of storage represents substantially the entire possibilities of the watershed of the Black river, with the exception of a large storage project at and above Carthage which was outlined by the Deep Waterways Board in their report of 1900. According to our characteristic curve for the Black river, the ultimate reasonable storage capacity of the stream at Carthage, amounts to 40,000,000 cubic feet per square mile, or a total of 73,000,000,000 cubic feet, producing a regulated minimum flow of 3,060 cubic feet per second. To increase the regulated flow from 1,776 cubic feet per second, furnished by the five reservoirs above mentioned, to this maximum regulation of 3,060 cubic feet per second would require 32,000,000 cubic feet of storage per square mile or 58,000,000,000 cubic feet of storage in addition, which can only be obtained by the reservoir above Carthage. There would be required a dam with crest at elevation 772 at least, flooding about 74 square miles or 48,760 acres of land lying between Carthage and Lyons Falls, with a flow line at elevation 772. This is substantially the same reservoir as that studied by the Deep Waterways Board and it was then estimated to cost in the neighborhood of $6,000,000. I should say that this estimate is too low rather than too high, taking into account present economic conditions and the fact that much of this bottom land has proved to be, once the snags and old tree stumps have been removed, well adapted for cultivation, in fact, rather valuable. From the above considerations I should say that this reservoir would cost probably not less than $7,000,000. From Carthage to Dexter, there is a fall of 417 feet already developed or capable of development. An increase in the regulated flow of 1,284 cubic feet per second or from 1,776 cubic feet per second to 3,060 cubic feet per second would make available under this 417 foot head, 46,200 additional 7-day, 24-hour horsepower among the plants below Carthage. This makes the cost per horsepower for water alone furnished to the plants between Carthage and Dexter $150 per horsepower, which is far more expensive than the cost for any of the smaller projects noted in the headwaters, in this report, and renders this project at the present time not attractive.

Any reduction in the capacity of the reservoir above Carthage will tend to increase rather than diminish this cost per horse-



Black River.
Power dam at Herrings, between Carthage and Dexter.

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power, because as the capacity of the reservoir is reduced the flowage and consequent land damages reduce much more slowly. A reservoir, covering such enormous acreage as this one would, and drawn down at times so as to expose an enormous tract of bare surface, will not be attractive for the territory immediately surrounding it, and this sacrifice should not be made, if made at all, except for very extensive benefits and benefits which are the maximum obtainable. However, if ultimately all the possible power is to be obtained between Carthage and Dexter, it will be necessary to construct this reservoir and for that reason it may be well to obtain some measure of control over the flooded property sufficient to prevent the construction of expensive undertakings upon this land which would render the construction of this reservoir in the future utterly impracticable.

RECOMMENDATIONS.

Of all the rivers in the northwestern portion of the State covered by this reconnaissance, the Black river watershed presents by far the most noteworthy opportunities for the conservation of the water power which runs to waste during the wet months of the year, presents the best market for such power when developed and shows the most complete utilization of the power already available. In view of the importance of this stream as a power producer, accurate surveys and studies more in detail than has been practicable in a reconnaissance should be made as soon as is practicable to enable preliminary designs of dams and estimates of cost to be prepared and to enable a more complete study to be made of the amount, cost and availability of the resulting increase in developed and undeveloped power. This will place the more feasible of these projects in the same position as to speedy action whenever construction shall be determined upon as are the projects on the Hudson and Raquette rivers. While not presenting the greatest results in the way of increased power, yet because of the fact that there are no State lands within the Adirondack Park limits involved, the Hawkinsville reservoir suggests itself as the most available for early detailed examination and study. The Beaver, and especially the Moose river reservoirs show much larger returns in increased water power, but as they both involve the flooding of State land within the limits of the Adirondack Park, they are not as readily available for immediate consideration as the above. The first requisites for a further study of these projects are surveys at the dam sites to enable preliminary designs and estimates to be made and a completion of the river profiles of the Beaver and Moose rivers below the reservoirs. As to the reservoir site at Copenhagen, on the Deer river, which does not present such attractive promise for power regulation as the other reservoirs noted, further consideration might well wait until such time as its usefulness as a storage reservoir for domestic supply as well as for power regulation has received more attention than at present.

OSWEGATCHIE RIVER.

The Oswegatchie river rises in Cranberry lake and the mountains to the southwest in St. Lawrence and Jefferson counties, from thence it flows in a general northerly direction to the St. Lawrence river at Ogdensburg where its drainage area is 1,609 square miles. Its principal tributary is the Indian river which flows through Black lake and enters into the Oswegatchie near Galilee. The main river divides into two branches at Dodgeville. The east branch rises in Cranberry lake and the west branch in the mountains above Jerden Falls. There is considerable developed power along all three of these streams and quite a number of undeveloped sites. The drainage areas at the several points in this watershed considered in these studies are shown in the following table:

WATERSHED AREAS OF OSWEGATCHIE BASIN.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated point.
	Feet.	*Sq. miles.*
Oswegatchie below junction of Indian river	270	1,577
Oswegatchie above junction of east and west branches	270	1,033
Oswegatchie below junction of east and west branches	561	630
East Branch above junction with west branch	561	358
East Branch at Newton Falls	1,440	188
West Branch above junction with east branch	561	272
West Branch at Harrisville	787	181
Indian river at junction with Oswegatchie	270	544

On the east branch there are two important possibilities for storage; one at Cranberry lake, the other at Newton Falls. Cranberry lake, at elevation 1,540 feet above the sea, is in part a large artificial pond with a surface of about 12.8 square miles, or 8,192 acres, formed by a dam built many years ago by a commission acting under authority from the Legislature. The flowage is now owned by the State and the regulation of stream flow therefrom is under State control. In the past this lake has been very extensively used for regulating purposes in the interests of the power plants below. This regulation has been greatly curtailed of late years because of the protests of property owners along the shore of the lake, and last year a maximum of eight feet depletion was available in place of the fourteen feet which had been used in the past. Fourteen feet depletion represents a storage of about 2½ billion cubic feet, whereas eight feet depletion represents only about 1.9 billion cubic feet of storage. One of the principal reasons that the drawing down of Cranberry lake is so injurious to property owners lies in the manner in which the forests flooded were treated at the time when the storage reservoir was built, no attempt being made to clear the margins of the lake by removing the unsightly stumps and dead timber. Should the height of the present dam be increased five feet, the shore line properly treated, and the present unsightly stumps sawed off, it would be possible to draw the new surface of the lake down ten feet, or five feet below the present surface without rendering it a nuisance. This would produce 3.6 billion cubic feet of storage in place of approximately 1.9 available last year. Above Newton Falls there is a very extensive tract of swamp land covered with brush and dead trees. I should say that at least 7 square miles, or 4,480 acres of this swamp would be flooded to a depth of 15 feet by raising the crest of the present dam at Newton falls 20 feet. With 10 feet depletion, this would give a storage capacity of 2 billion cubic feet and leave most of the swamp covered with water at all times. There is a gap to the south of Newton falls where a low barrier, but of considerable length, would have to be erected to prevent the impounded water from spilling over into an adjoining tributary of the Oswegatchie. From Newton falls to Dodgeville the river has a fall of about 879 feet in a distance of 23 miles or at the rate of 38 feet per mile. Of this fall 129 feet is already developed. Of the remaining 750 feet I consider from a personal examination that it would be safe to count on 375 feet as capable of ready development in case regulation was obtained. This would make a total development of 504 feet out of a total of 879, whereas from Dodgeville to the St. Lawrence river there are developments and possibilities of a total of 263 feet out of a total fall of 318, or about three-quarters as against five-ninths estimated for the stream above Dodgeville, which indicates our estimate of developable power to be a moderate one. The two reservoirs at Newton falls and Cranberry lake would probably most economically be regulated for uniform flow at a point halfway between Newton falls and Dodgeville.

On the west branch of the Oswegatchie, the best site for storage lies just above Harrisville where a dam 40 feet high, on rock foundation and of moderate length, would flood, I should say, at least 2⅔ square miles, or 1,700 acres at elevation 865 feet above sea level. A considerable proportion of this land is swampy; the rest of only moderate value and fertility. Such a reservoir would store about 1.3 billion cubic feet of water for regulation. Should farther study and surveys show a greater practicable height of dam, this storage could be materially increased. Above this point there are some heavy falls, including Jerden, Kilburn and Sluice falls, aggregating several hundred feet, and also some storage basins of considerable capacity, notably at Alder, beds about twenty-three miles above Harrisville; however, the drainage area above these basins is so small that I do not believe any important storage could be obtained whereby their development would be made especially attractive and any material regulation of the Oswegatchie be obtained. The fall from Harrisville to Dodgeville amounts to 226 feet in a distance of 11 miles, or at an average rate of 20 feet per mile. This stretch is not particularly favorable for power development, the country being quite open and sandy, with few rock outcrops suitable for dams and the slope of the stream in the main uniform. I should say that 40 feet would represent the probable limits of its possibility for undeveloped power mostly concentrated at or below Fullerville. From Dodgeville to Ogdensburg there are about 12,000 horse-power developed at the present time, which with the exception of a 20-foot possibility near Homestead, 12 feet at Cooper falls, 12 feet near Galilee, a 25-foot possibility at Fowler, and a small addition to the present head at Hailesboro, represents the most important possibilities for power of this portion of the stream, without regulation.

On the Indian river, the possibilities for storage of adequate volume combined with sufficient fall to be benefited thereby are not very promising. There is said to be some storage already obtained by private enterprise from Lake Bonaparte, the water being sold to the power plants down stream. At Indian lake, which has a great deal more drainage area than Lake Bonaparte, some additional storage could be obtained of an unknown quantity but not of sufficient quantity to be of importance. Five or six miles above Natural Bridge there is a basin said to contain about 1,000 acres. The drainage above this basin, however, is so small that no material amount of storage capacity could be fully utilized. At Natural Bridge there is 54 feet of head partly utilized, however, which would be benefited directly by such storage as well as the sites downstream. From Indian lake to Philadelphia, a distance of 35 miles, the river has a fairly uniform slope of 11 feet to the mile. There are some sites for power in this stretch, practically all of them, however, utilized for their full head. From Philadelphia to the beginning of Black lake, a distance of 32 miles, the river has a very moderate average slope of 6 feet to the mile. This is quite uniformly distributed, with the exception of 81½ feet of fall near Theresa either developed or in process of development and a moderate possibility said to exist at Rossie. With these exceptions there are no specially favorable undeveloped sites for power development even under a comparatively small head. Black lake has been suggested as offering possible opportunities for storage for regulation purposes and this matter has been looked into quite carefully. The area of Black lake is 17.8 square miles and its water surface is at elevation 272 feet above the sea. At the Eelweir bridge near Galilee on the

Oswegatchie there is a point where the river flows through a narrow channel with banks about 10 or 15 feet high. At this point some form of shutter dam could be built raising the water level at that point 10 feet and raising the level of Black lake 8 feet as against a normal flood level of 6 feet. Such a dam in addition to raising the level of Black lake would flood about 1,200 acres of partly cultivated land and would have a storage capacity above the present lake surface of 4.17 billion cubic feet which would be fed by both the Indian and Oswegatchie rivers. The regulated flow from this reservoir would increase, over and above the regulation produced from the other reservoirs above-mentioned, the minimum power for the 9-foot (minimum) head at Ogdensburg to the extent of 560 horsepower, and by means of a head-race canal about 4,000 feet long, or a dam at the foot of the rapids, an undeveloped power with an available head of 14 feet, at the foot of these rapids, to the extent of 874 horsepower, but would at the same time destroy 8 feet of head at Heuvelton, producing at the present time 260 horsepower. The net gain in power would thus be about 1,200 continuous net 24-hour horsepower, which is a very small amount of power to be derived from such a project. However, there are other considerations, such as the possible use of this reservoir for improving the supply of water to the city of Ogdensburg for domestic purposes, which might render such a project advisable even though otherwise not financially attractive. At the lake's outlet above Galilee there is said to be at least one location, near the highway bridge, which should be carefully considered before any final decision is reached upon the relative advantages of damming Black lake above or below its junction with the Oswegatchie.

The power capacities to be derived from a utilization first, of the storage possibilities at Cranberry lake and Newton falls; second, of the storage possibilities of these two reservoirs and also of the Harrisville reservoir are shown on the accompanying tables. The figures of these tables are based upon a rate of run-off of the Oswegatchie river at the points for which a uniform regulation would be attempted, equal to that obtained by direct gaging near the mouth of the river at Ogdensburg, and upon an assumed storage capacity, which is in the main only a very rough approximation. Owing to this incomplete data, the figures are, therefore, subject to revision when a fuller knowledge of the flow of the river in its upper reaches is obtainable, and some surveys have been made of the storage reservoir basins noted.

ESTIMATE OF AVAILABLE POWER ON OSWEGATCHIE RIVER.

For flow with existing storage of 2.5 billion cubic feet at Cranberry Lake and for Regulated flow due to 3.0 billion cubic feet of additional storage at Cranberry Lake and Newton Falls, flow based on conditions shown by gaging at Ogdensburg 1903–1907 inclusive.

(7-day, 24-hour net horsepower at wheel shaft, with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	FLOW DUE TO EXISTING STORAGE OF 2.5 BILLION CUBIC FEET.		REGULATED FLOW DUE TO 3 BILLION CUBIC FEET ADDITIONAL STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow due to additional storage.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*C. F. S.*	*Net H. P.*	*C. F. S.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED.									
Newton Falls	188	42	42	....	1,038	171	616	392	1,440
Newton Falls	188	....	10	....	....	171	147	392	338
South Edwards	288	....	32	....	1,353	228	630	422	1,165
Edwards	321	41	12	....	80	239	248	433	450
Talcville	345	41	17	....	400	245	360	439	645
Dodgeville	630	40	26	....	1,050	330	740	524	1,175
Emeryville	642	....	33	....	2,061	334	965	528	1,500
Fowler	648	39	15	....	601	336	435	530	685
Fowler	648	....	25	....	....	336	725	530	1,140
Hailesboro	668	38	49.6	....	2,474	342	1,460	536	2,290
Hailesboro	668	....	7.4	....	....	342	218	536	342
Gouverneur	684	37	8.5	....	405	347	255	541	396
Natural Dam	684	....	20	....	2,500	347	598	541	934
Natural Dam	684	....	9.5	....	350	347	285	541	444
Wegatchie	684	....	22	....	285	347	658	541	1,027
Wegatchie	684	....	11.7	....	180	347	350	541	545
Rensselaer Falls	922	....	7	....	400	418	252	612	368
Heuvelton	990	36	8.4	....	260	438	318	632	457
Ogdensburg	1,609	35	9	....	1,775	628	487	822	636
	....	....	375.7	....	15,012	....	9,747	....	16,077

WATER POWER UNDEVELOPED.									
Between Newton Falls and Dodgeville	273	41	375	....	....	232	7,500	426	13,750
Between Homestead and Wegatchie	684	36	30	....	....	347	895	541	1,402
Coopers Falls	922	36	12	....	....	418	433	612	633
Opposite Galilee	1,609	35	12	....	....	628	650	822	850
	....	....	419	....	....	....	9,478	....	16,635
	....	....	804.7	....	15,012	....	19,225	....	32,712

Estimate of Available Power on Oswegatchie River.

For flow due to existing storage of 2.5 *billion cubic feet at Cranberry Lake and for regulated flow due to* 4.3 *billion cubic feet of additional storage at Cranberry Lake, Newton Falls and Harrisville, flow based on conditions shown by gagings at Ogdensburg* 1903–1907 *inclusive.*

(7-day, 24-hour net horsepower at wheel shaft, with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	Flow Due to Existing Storage of 2.5 Billion Cubic Feet.		Regulated Flow Due to 4.3 Billion Cubic Feet Additional Storage.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow due to additional storage.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*C. F. S.*	*Net H. P.*	*C. F. S.*	*Net H. P.*
Water Power Fully or Partly Developed.									
Newton Falls	188	42	42	....	1,038	171	616	392	1,440
Newton Falls	188	....	10	....	....	171	147	392	338
South Edwards	288	....	32	....	1,353	228	630	422	1,165
Edwards	321	41	12	....	80	239	248	433	450
Talcville	345	41	17	....	400	245	360	439	645
Harrisville	181	43	61	....	1,915	58	305	217	1,140
Fullerville	248	41	31.7	....	1,170	80	218	239	652
Dodgeville	630	40	26	....	1,050	330	740	683	1,530
Emeryville	642	....	33	....	2,061	334	965	687	1,935
Fowler	648	39	15	....	601	336	435	689	890
Fowler	648	....	25	....	....	336	725	689	1,480
Hailesboro	668	38	49.6	....	2,474	342	1,460	695	2,970
Hailesboro	668	....	7.4	....	....	342	218	695	443
Gouverneur	684	37	8.5	....	405	347	255	700	511
Natural Dam	684	....	20	....	2,500	347	548	700	1,208
Natural Dam	684	....	9.5	....	350	347	235	700	574
Wegatchie	684	....	22	....	285	347	658	700	1,329

Wegatchie	684	....	11.7	....	180	347	350	700	707
Rensselaer Falls	922	....	7	....	400	418	252	771	464
Heuvelton	990	36	8.4	....	260	438	318	791	572
Ogdensburg	1,609	35	9	....	1,775	628	487	981	759
	....	....	456.8	....	17,747	....	10,270	....	21,202
WATER POWER UNDEVELOPED.									
Between Newton Falls and Dodgeville	273	41	375	....	....	232	7,500	426	13,750
Between Fullerville and Dodgeville	260	41	40	....	....	80	276	239	825
Between Homestead and Wegatchie	684	36	30	....	....	347	895	700	1,812
Coopers Falls	922	36	12	....	....	418	433	771	796
Opposite Galilee	1,609	35	12	....	....	628	650	981	1,015
	....	....	469	....	....	....	9,754	....	18,198
	....	....	926.8	....	....	....	20,024	....	39,500

RECOMMENDATIONS.

Of the above reservoirs in the Oswegatchie watershed, the most promising for storage and resulting power is that at Cranberry lake, provided surveys and borings indicate the feasibility of raising the crest of the present dam five feet. The regulation of the Oswegatchie from this lake is very important for the large number of power plants between Newton Falls and Ogdensburg, and consequently the demand for the power produced by regulation from storage is well assured. To enable this project to be considered in a very satisfactory manner necessary surveys and borings at the dam site should be made and a stadia profile should be run from Newton Falls to Heuvelton Falls, to enable a more complete estimate to be made of the extent of undeveloped power possibilities. In case the Cranberry lake proposition should prove impracticable, or a greater amount of storage should be needed for regulation, a survey should be made of the basin immediately above Newton Falls to determine its extent and how much of a barrier would have to be built across the low stretch of ground south of the dam site at Newton Falls. Almost all the regulation which would be obtained from the Harrisville reservoir would affect only those plants on the Main river between Dodgeville and Ogdensburg, so that until there becomes a demand for regulation beyond that obtainable from Cranberry lake or the Newton Falls reservoir, there will be no need of any special consideration of the Harrisville project.

GRASS RIVER.

The Grass river, with a drainage area at its mouth of 637 square miles, rises at the foot of Long Pond mountains to the east of Cranberry lake, at elevation of 1,740 feet above the sea. Thence it flows northerly ten miles to the Grass river flow through a flat swampy plateau with a minimum elevation of 1,520 feet above the sea. Thence northwesterly thirty miles to Russell, through a rough mountainous well-wooded country in which the fall of the stream is about 950 feet. Practically all of the undeveloped power possibilities of the stream lie in this portion of its course. Finally it flows northerly fifty-two miles from Russell to its junction with the St. Lawrence river below Massena. Throughout its entire

OSWEGATCHIE RIVER — DAM AT OUTLET OF CRANBERRY LAKE.
It is proposed to increase the height of this dam five feet for additional storage.

OSWEGATCHIE RIVER — CRANBERRY LAKE.
An artificial storage reservoir — Additional storage proposed by raising the water level five feet.

length the Grass river drains a narrow watershed containing, except on the middle branch comparatively few lakes or opportunities for natural storage. The drainage area at the several points considered in this study are shown on accompanying table. Below Russell the fall of the stream to the St. Lawrence is 400 feet, of which 40 per cent. is already being used for power. This might be increased to 50 per cent. by improvements at existing sites and by further developments. While there is a great hydraulic power plant on this river at Massena, owned by the St. Lawrence Power Company, developing 35,000 horsepower under forty-two feet head, water for this development is brought by a canal from the St. Lawrence river above the Long Sault Rapids and is not properly to be treated as a development on this stream but rather as one along the St. Lawrence river. The three points in this watershed presenting the most attractive possibilities for storage are to be found.

First. At the Grass river flow on the south branch where there is at present an old earth and crib dam said to have been built and to be under the control of the State, in such a bad state of repair as to present a serious menace to the valley below in time of flood. Replacing this dam by a substantial concrete and earth dam founded on rock, and with crest at elevation 1,540, or not more than ten feet above the top of the present structure, more than 3,600 acres of worthless swamp would be flooded to a depth of slightly more than twenty feet producing 3.5 billion cubic feet of storage, with twenty feet depletions, leaving the swamps at all times covered with water. This reservoir would be within the limits of the Adirondack Park but contains no State land.

Second. Two miles above Clare, on the north branch of the Grass, there is an extensive stillwater at about elevation 945 feet above the sea. There is at present an old disused timber dam formerly used for logging purposes. A concrete dam twenty feet high, founded on rock, would flood in the neighborhood of 1,200 acres, mostly swamp and cut over timber land of no special value. The reservoir thus formed would impound in the neighborhood of one-half billion cubic feet of water.

Third. There is a long and narrow basin extending from a point just below DeGrasse to Clare. By building two dams, one across the main branch of the river, three miles below DeGrasse, where

ESTIMATE OF AVAILABLE POWER ON GRASS RIVER

For Natural flow and Regulated flow due to 5 billion cubic feet storage at De Grasse, Clare and Grass River flow, character of stream flow assumed to be the same as for long term conditions on the Raquette River.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW. Minimum average monthly flow in ordinary year.	NATURAL FLOW. Minimum average monthly net horsepower in ordinary year.	REGULATED FLOW DUE TO 5 BILLION CUBIC FEET STORAGE. Minimum average monthly flow after regulation.	REGULATED FLOW DUE TO 5 BILLION CUBIC FEET STORAGE. Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*C. F. S.*	*Net H. P.*	*C. F. S.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED:									
Russell	256	39	10	....	....	54	46	415	355
Pyrites	316	....	78	....	2,250	66	443	427	2,860
Canton	....	38	24	....	695	108	220	469	945
Morley	535	....	8	....	....	112	75	473	325
Bucks Bridge	542	....	9	....	....	114	88	475	365
Madrid	566	37	8	....	150	119	82	480	330
Chase's Mills	585	....	8	....	....	123	85	484	333
Lewisville	595	....	9	....	....	125	97	486	375
Massena	610	36	8	....	....	128	88	489	335
Total fully or partly developed	....	....	152	....	3,095	....	1,224	....	6,223
WATER POWER UNDEVELOPED:									
Between New Bridge and Clifton	....	40	240	....	....	27	555	229	4,735
Clare	....	38	200	Inter	mittant.	....	....	51	880
Russell	256	39	180	....	....	54	840	415	6,450
Total undeveloped	....	....	620	....	....	....	1,395	....	12,065
Total	....	....	782	....	....	....	2,719	....	18,288

the river flows over a rock ledge with a sheer fall of forty feet, and another dam on the north branch about one-half mile below Clare, the two dams to have a height of about thirty-five feet and a possible aggregate length of 2,000 feet. These two dams would flood about 1,600 acres to a mean depth of fifteen feet, producing at least 1,000,000,000 cubic feet of storage.

The regulated flow from the north branch reservoir could be utilized for power immediately below the dam under 200 feet head by means of two and one-half miles of pipe line. The regulated flow from the south branch reservoir could be utilized between New Bridge and Clifton, where there is a fall of 305 feet in five miles, or at the rate of sixty feet per mile. There are numerous rock outcrops and some precipitous falls. I consider it safe to assume that 80 per cent. or 240 feet of this head could be utilized by means of diverting dams, and not more than an aggregate of four miles of pipe line. The regulated flow from all three reservoirs could be utilized to develop power between Clare and Russell, where a fall of 180 feet could be utilized by means of two and one-half miles of pipe line. Between New Bridge and the Grass river flow, a distance of some twelve miles, the fall of the river is comparatively uniform and at an average rate of twenty-five feet per mile. The moderate slope of the river, and the scarcity of bold, rocky outcrops, together with the reduced flow of the stream, at times, because of the shutting down of the gates of the Grass river flow would probably make any considerable development of the power along this portion of the river unattractive. In addition to the three undeveloped powers above mentioned, which would be rendered thoroughly feasible should the reservoir be constructed with the flow regulated for Russell, there would be a very material increase in the normal minimum stream flow throughout the entire course to the mouth, which would create a very material benefit for the power already developed, which utilizes about 160 feet of head. A table is here added showing the power at present developed with unregulated flow, the same power with flow as regulated from the proposed reservoirs and undeveloped power, which would be made feasible by their construction, provided our assumptions as to stream flow and storage capacities are confirmed. Therefore, owing to necessarily incomplete data as to reservoir capacities and to the lack of stream flow records on the Grass river, the figures in this table are subject to revision.

WATERSHED AREAS OF GRASS RIVER BASIN.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated point.
	Feet.	*Sq. miles.*
Grass river at mouth	158	622
Grass river at Russell above Plum creek	565	256
North Branch at Stillwater above Clare	1,098	20
Middle Branch at mouth	765	70
South Branch at De Grasse	785	127
South Branch at Grass river flow	1,520	37

In the Grass river studies, the capacity of the south branch reservoir is in part obtained from topographical maps of the United States Geological Survey, so that the figures given represent a somewhat closer approximation of the storage than will be found for some of the other reservoirs. With that exception, the figures for undeveloped power and storage are based entirely on reconnaissance work and merely represent possibilities and indications as to the most favorable points of study in case it were decided at some future time to take up the matter more in detail.

RECOMMENDATIONS.

The power opportunities on the Grass river are so far removed from any possible market at the present time that there seems to be no need of further study of storage possibilities or power development upon this stream until there shall be a sufficient demand for power to justify it. The upper portion of the watershed where the power possibilities are situated is wild and very sparsely settled. However, the condition of the dam at the Grass river flow is such a menace not only to the valley immediately below it but also to the lower reaches in the vicinity of Canton, that the proper authorities should either entirely remove it or replace it at an early date by a suitable structure, preferably of concrete founded on rock, so that there will be no danger of its failure and consequent damage to the valley below. I estimate that at the time of high water there is possibly as much as 2,000,000,000 cubic feet of water temporarily held back by this dam, and the possibility of its sudden release is quite appalling.

ST. REGIS RIVER.

The St. Regis river rises in several streams among the lakes and swamps of the plateau between Debar mountains and Upper Saranac lake, at an elevation of about 1,500 feet above the sea. First it flows in a northwesterly direction forty miles and then somewhat east of north twenty-eight miles to its mouth in the St. Lawrence river near the State line where it has a drainage of 664 square miles. The upper portion of this watershed consists of swamps and mountains from which the forest has been quite generally denuded. On the West Branch, owing to its inaccessibility there is a very large amount of hard wood still standing. Upon leaving the plateau the stream descends for ten or fifteen miles, through a rugged country with a succession of steep rapids and precipitous falls to the lower country bordering the St. Lawrence. There are excellent opportunities for developing power in this descent, only a few of which have as yet been utilized. From the foot of the hills to the St. Lawrence the slope of the river is moderate, and rock out-crops not frequent, consequently favorable sites for power development are scarce. The present limit of profitable development of power through this low country, except as increased by regulation of stream flow, has probably been reached in the existing plants.

No records of the flow of the St. Regis river, or any of its boundaries are available so that it has been impossible to make mass and characteristic curves for these streams; however, in location, general shape and character of the watershed they approach quite nearly to the Raquette river. Consequently the characteristic curve for the Raquette at Colton has been used in determining the probable regulation of flow to be derived from the storage produced by the reservoirs noted.

The principal tributary of the St. Regis is the Deer river. No favorable sites for storage were observed on this river although it was explored as far as Reynoldston. Above that point the drainage area is too small to utilize much storage. From Tebo to North Lawrence, a distance of twelve and one-half miles, the average slope of the stream is sixty-one feet per mile and there are numerous opportunities for the construction of small power plants utilizing what flow there is in the stream. This has been done at Dickinson Center but elsewhere little or nothing has been done. Below North Lawrence the slope of the river is only ten feet per mile, affording no attractive sites for power. There are 767 feet of fall between Tebo and North Lawrence, of which I should say 60 per cent. or 460 feet would be attractive for development if regulation were obtainable. The country above Tebo is wild and there are no maps with requisite data so it is possible that a more extended examination might disclose some storage above Reynoldston, in which case the above possibilities would indicate the value of the storage obtainable.

From Winthrop to the State line, a distance of eighteen miles, the St. Regis has an average slope of nine feet per mile. There are no important possibilities below Winthrop, except at Brasher Falls and at Hogansburg, where the power is already developed. Above Winthrop the river divides into the east and west branch.

On the east branch two considerable storage basins were noted, one just above St. Regis Falls, the other just above Santa Clara. The St. Regis Falls basin has an area of at least 1,440 acres, consisting almost entirely of unsightly swamps devoid of forest. By raising the crest of the present dam at St. Regis Falls twenty-five feet, a storage of at least 1.5 billion cubic feet could be obtained. At Santa Clara a dam forty feet high would raise the water to a level of about twenty feet above the railroad tracks. This would flood at least 620 acres and produce 1.0 billion cubic feet of storage. These figures are based on what can be actually seen, but I should say from a general examination of the basins that the above represents the extreme minimum possibility and that the actual storage would exceed the above amounts by anywhere from 50 to 100 per cent. These two storage reservoirs, if built, would necessitate the relocation of some ten or twelve miles of the New York and Ottawa railroad, which is a single track line. The country, however, is easy and the present grades almost level, making the cost of such a change moderate.

The continuous regulated flow of the east branch at St. Regis Falls as derived from the characteristic curve for the Raquette

St. Regis River — St. Regis Falls.
On the east branch — View down stream.

St. Regis River — St. Regis Falls.
View up stream toward dam site.

is 288 c. f. s. against 98 c. f. s. without regulation. Below St. Regis Falls there is within a distance of one mile, a fall of 175 feet, of which only 52 feet is at present developed. With the regulation produced by the proposed reservoir, the whole of this fall would undoubtedly become attractive for development. From the foot of the steep fall at St. Regis Falls to Nicholville, a distance of six miles, the river has a fall of 335 feet. The river flows through a narrow, rocky gorge in a succession of small precipitous drops succeeded by long stretches of uniform and steep slopes. I should say that practically all of this head could be developed either by a succession of low dams and somewhat lengthy pipe lines, or else in connection with the very steep drop at St. Regis Falls. In that case, with a pipe line not more than seven miles long, a power could be developed using 510 feet of fall. From Nicholville to Buckton, a distance of seven miles, the river has a slope of 52 feet per mile. By a series of low dams and somewhat lengthy pipe lines, about 80 per cent., or say 300 feet, of this fall could be utilized for the development of power.

On the west branch of the St. Regis two promising sites for storage were noted. First, above Sylvian Falls at elevation 1,120, there is a still water some three miles in length flowing through a flat basin quite well wooded and containing about 1,000 acres. A dam at the crest of the falls, 30 feet high, about 800 feet long, founded on rock, would produce at least 1.2 billion cubic feet of storage. The storage may possibly be considerably greater, as it was not practicable to get a very clear outline of the extent of this basin. While the basin is covered with good second growth, yet it is, under the present conditions, doomed, as it is owned by one of the lumber interests which plan to cut down the timber as soon as opportunity offers. Five miles above this stillwater is an even more extensive one, five miles in length, with a great deal of swamp ground on either side of the stream. I should say that this basin has an average width of at least one-half a mile. At the lower end of the stillwater, at the site of what is said to be an old State dam, at present in ruins, a dam 40 feet high, founded on rock, would flood at least 1,500 acres and produce, probably, at least 1.8 billion cubic feet of storage. The land thus flooded contains very little timber land and is for the most part swampy and valueless. There are said to be some extensive stillwaters and marshes much further up the stream. They were too inaccessible to be reached by me with the time at my command. However, I think it is doubtful if any would be found that are not too near the headwaters of the stream to have sufficient drainage area to properly utilize any considerable basin. Just below Sylvian Falls there is a precipitous drop of 50 feet and within a mile and a half there is a total fall of 150 feet, all of which could be developed to advantage in case the proposed reservoirs were built. From this point to the back water above Parishville, a distance of three miles, there is a fall of 70 feet, or at the rate of 23 feet per mile. There are some excellent sites for low dams founded on rock which could utilize ten or fifteen feet head. I should say that probably 40 per cent., or 30 feet, of this fall could be utilized for power. Below Parishville the river flows in a series of precipitous drops separated by stillwaters of a mile or less in length for six miles to a point just below Southville. In this distance the fall is 420 feet, or at an average rate for the six miles of 70 feet per mile. From an examination of the sites for dams practically all of this head could be utilized for power. From Southville to Winthrop, a distance of twelve miles, the river has a fall of 167 feet, or at the rate of 14 feet per mile. With the exception of a site at West Stockholm, at present developed, there are no promising opportunities in this stretch. As in the case of the east branch, regulated and unregulated flow derived from the mass and characteristic curves of the Raquette are used in studying the benefits to be derived from the possible storage on the west branch. The accompanying table shows these benefits for the entire watershed, provided our assumptions as to stream flow and storage capacities are confirmed. Consequently the figures are to be used with caution and are subject to revision.

ESTIMATE OF AVAILABLE POWER ON ST. REGIS RIVER.

For Natural and for Regulated flow due to 5.5 billion cubic feet of storage in reservoirs at St. Regis Falls, Santa Clara, Sylvian Falls and 5 mile Stillwater for long term conditions assuming character of flow the same as for the Raquette at Colton.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 5.5 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED:									
St. Regis Falls	244	36	36	....	678	98	304	288	892
Nicholville	268	....	18	....	800	107	166	297	460
Fort Jackson	306	36	11	....	485	122	115	312	296
Parishville	175	38	55	....	645	70	332	268	1,270
Allens Falls	196	....	12	....	115	78	80	276	285
West Stockholm	206	37	10	....	330	82	70	280	242
Brasher Falls	622	36	22	....	480	249	472	637	1,205
Hogansburg	664	36	9	....	66	266	207	654	507
	....	....	173	....	3,599	....	1,746	....	5,157
WATER POWER UNDEVELOPED:									
St. Regis Falls	244	36	139	....	....	98	1,175	288	3,450
St. Regis Falls to Nicholville	....	....	299	....	....	98	2,520	288	7,410
Nicholville to Buckton	306	36	300	....	....	122	3,160	312	8,070
Sylvian Falls	170	38	150	....	....	68	878	266	3,440
Parishville	175	....	30	....	....	70	181	268	696
Parishville to Southville	....	38	388	....	....	70	2,340	268	8,950
	....	....	1,306	....	....	....	10,254	....	32,016
	....	....	1,470	....	....	....	12,000	....	37,173

RECOMMENDATIONS.

On the east branch there seems to be at present no special demand for increased power, but the region is rendered fairly accessible by the New York and Ottawa Railroad, and I believe the demand for increased power is not very far distant. However, the reconnaissance shows with sufficient fullness and exactness, for purposes of comparison, the possibilities of this stream, and consequently there seems to be no need of further study of the watershed of this branch until there is a greater need for increased power, except a stadia profile from St. Regis Falls to Buckton to determine more exactly the amount and disposition of possible water powers to be benefited by the construction of the reservoirs noted, also surveys to show with some degree of definiteness the extent of these reservoir sites. On the west branch the power possibilities to be developed from the above storage are so far removed from any market or demand for power as to make any further study of this stream unnecessary at the present time.

WATERSHED AREAS OF ST. REGIS RIVER BASIN DERIVED FROM POSTAL MAP OF NEW YORK STATE.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated point.
	Feet.	*Sq. miles.*
St. Regis river at State Line	....	910
St. Regis river at Winthrop	313	595
East Branch at Winthrop	313	347
East Branch at Nicholville	725	268
East Branch at St. Regis Falls	1,235	244
West Branch at Winthrop	313	280
West Branch at Parishville	622	175
West Brahch at Sylvian Falls	1,120	170
Deer river at mouth	726	212
Deer river at Tebo	1,110	54

SALMON RIVER (FRANKLIN COUNTY).

The Salmon river, with a drainage area at Malone, the present center of power development, of 179 square miles, and at the State line of 480 square miles, rises at the foot of Loon Lake mountains in the southern part of Franklin county, at an elevation of 1,660 feet above the sea. Thence it flows in a northerly direction for forty miles to the point where it leaves the State. The first fourteen miles of its course is through a comparatively level plateau with a minimum elevation of 1,285 feet above the sea. Upon leaving this plateau at Titusville or Chasm falls, the river flows through a deeply eroded gorge about one mile in length, in which it descends 270 feet, made up of precipitous falls and steep rapids. Then follow two miles of rapids with a quite uniform drop of seventy feet per mile. Thence to Malone, a distance of six miles, the river falls at a uniform rate of twenty feet per mile over a gravel bed, without any opportunities for any considerable development of power. Within the limits of Malone there is a total fall of about sixty-five feet. Here the river flows through another rock gorge in which almost the entire head is developed at the present time. In the next four miles the river falls 240 feet, or at the rate of sixty feet per mile over a succession of precipitous or vertical drops, separated by swift rapids, affording several excellent sites for power. Only one of these sites has as yet been developed. From this point to the State line, the country is comparatively flat and the stream has an average fall of less than twelve feet per mile. Some power has already been developed in this stretch at Westville and Fort Covington. Otherwise there are no noteworthy power possibilities here.

One promising storage basin in this watershed was noted just above Titusville, where the drainage area is 116 square miles, and where a masonry dam thirty-four feet high founded on rock and of moderate length across the narrow rock gorge, would flow 3,190 acres of swamp and low ground to elevation 1,320 feet above sea level, and would impound 2.5 billion cubic feet of water for stream regulation. The flooded area will be 4.3 per cent. of the drainage area at the dam site, and the storage will be at the rate of twenty-two million cubic feet per square mile of that area. The reservoir will flood about 1,200 acres of State land outside, however, the limits of the Adirondack park, and with what timber land it contains, composed mainly of small second growth partly burnt over. As no gaging records are available for this river, the long term characteristic curve for the Raquette river at Colton has been used in determining the amount of regulation obtainable from this reservoir. The two streams and their watersheds are very similar in character and these should give reasonably accurate results for a reconnaissance. It is, therefore, estimated that the above storage would increase the ordinary mean minimum monthly flow below Titusville by 148 c. f. s.

The power possibilities created or improved by this reservoir are very considerable considering the size of the watershed. There is a very noteworthy power possibility just below Titusville utilizing the flow from the reservoir under a mean head of 425 feet by conducting the water through a pipe line not more than three miles in length to the foot of the rock gorge. A small part of this head, fifty-six feet, is being utilized at the precipitous fall just below the dam site. Between this possibility and Malone the rate of fall, twenty feet per mile, is too slight for any considerable development. Within the stretch just below Malone, where the fall of the stream is 240 feet in four miles, there is already developed forty-five feet of head. For the remaining 195 feet there are at least two sites where with dams of moderate height, founded on rock and with comparatively short pipe line, an aggregate of 130 feet of head, could be utilized. Below this stretch there are no noteworthy opportunities for developing power. There is submitted herewith a table showing the developed and undeveloped power of the Salmon river, both with and without regulation from the proposed storage. There is considerable present demand for the power which would be made available by this project; Malone, a town of 11,000 inhabitants, being immediately at hand. Furthermore, it is situated in a prosperous country where interurban electric roads will doubtless prove feasible if cheap and reliable water-power were assured.

The accompanying table shows the results of our study of the effect of this storage upon the flow of the stream and upon existing power plants and possible power sites. The figures of this table, being based upon an assumed characteristic for the stream flow are to be taken with caution and are subject to revision.

WATERSHED AREAS OF SALMON (FRANKLIN CO.) RIVER BASIN DERIVED FROM MAPS OF U. S. GEOLOGICAL SURVEY AND FROM POSTAL MAP OF NEW YORK STATE AND RAILWAY MAP OF PUBLIC SERVICE COMMISSION.

DIVISION OF BASIN.	Elevation above sea.	Total area above stated points.
	Feet.	*Sq. miles.*
Salmon river at State Line	....	480
Salmon river at Fort Covington	....	284
Salmon river at Malone	700	*179
Salmon river at Titusville	1,285	11

*U. S. G. S.

RECOMMENDATIONS.

There is very good prospect of an early demand for increased water power along this stream, but I consider that the reconnaissance covers with sufficient fullness this proposition at the present time and until there is a definite demand for more power, there is no need of further study.

ESTIMATE OF AVAILABLE POWER ON SALMON (FRANKLIN CO.) RIVER.

For Natural flow and for Regulated flow due to 2.5 billion cubic feet of storage in reservoir at Titusville, assuming long term character of run off the same as that of the Raquette River at Colton.

(7-day, 24-hour, net horsepower at wheel shaft with 80 per cent. efficiency.)

PLACE.	Drainage area.	Mean annual precipitation.	Available gross head.	Distance in which fall occurs.	Capacity of present wheel installation.	NATURAL FLOW.		REGULATED FLOW DUE TO 2.5 BILLION CUBIC FEET STORAGE.	
						Minimum average monthly flow in ordinary year.	Minimum average monthly net horsepower in ordinary year.	Minimum average monthly flow after regulation.	Net 24-hour horsepower.
	Sq. Mi.	*Inches.*	*Feet.*	*Miles.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*	*Sec. Ft.*	*Net H. P.*
WATER POWER FULLY OR PARTLY DEVELOPED:									
Titusville	116	33	56	....	770	46	220	194	935
Whippleville	140	....	9	....	140	56	43	204	158
Malone	179	....	60	....	1,354	72	370	220	1,135
Malone L. & P. Co	187	....	45	....	1,475	75	290	223	865
Westville	196	....	18	....	199	78	120	226	350
Fort Covington	284	33	11	....	589	113	105	261	245
	....	....	199	....	4,527	....	1,148	....	3,688
WATER POWER UNDEVELOPED:									
Titusville	116	33	369	....	....	46	1,460	194	6,160
Malone to Westville	187	33	130	....	....	75	840	223	2,500
	....	....	499	....	....	....	2,300	....	8,660
	....	....	698	....	4,527	....	3,448	....	12,348

NOTE.—Flow from reservoir regulated to produce uniform flow from same.

ST. LAWRENCE RIVER.

On the St. Lawrence river proper there are several opportunities for the development of power utilizing the fall of the river at the several rapids. At the present time there is a large power plant at Massena which develops about 35,000 horsepower by leading the water of the St. Lawrence through a canal at the head of Long Sault Island to a power house on the Grass river near Massena, discharging the tailwater into that river. All of these possibilities on the St. Lawrence take advantage of some island situated in the river at the rapids, thus forming a natural headrace between the island and the New York mainland. The only possibilities here considered will be those not involving the building of dams or structures outside of the limits of New York State. The flow of the St. Lawrence, amounting to about 300,000 second feet would produce if the dams were constructed by international agreement across the river, a very great amount of power. There are two noteworthy opportunities for the development of power on the St. Lawrence river entirely situated inside of New York State.

At Waddington, by constructing a dam across the Little River from the town of Waddington to Ogden Island where there is excellent rock foundation, a head of about ten and one-half feet could be obtained and probably by some work upon the channel of the Little River sufficient water could be passed through the wheels at this point to produce about 30,000 horsepower.

Between the lower end of Long Sault Island and the mainland, it would be feasible, provided soundings should indicate suitable foundation at reasonable distance, to build a dam across the South Sault rapids with crest at elevation 203. This would render available twenty-nine feet of head, producing on the basis of the Waddington possibility about 90,000 horsepower, and at the same time would improve the access of water to the Massena power canal and plant. For the carrying out of this undertaking it would be necessary to construct a low dam or barrier across the Big Sny, to prevent the water from being dammed around the upper end of the Long Sault Island into the main channel of the St. Lawrence. A number of schemes have been studied at various times at this point, some of which involve the construction of dams entirely across the St. Lawrence river utilizing practically the entire flow of the river, which has a minimum of 187,000 c. f. s., for power and producing several hundred thousand horsepower. As these schemes, however, involve operations outside of New York State, and even of the United States, no discussion of them will be attempted here.

Very respectfully,
JULIAN THORNLEY,
Resident Engineer.

III.

REPORT

OF

ALBERT H. PERKINS, RESIDENT ENGINEER.

SURVEYS:
Schroon and Sacandaga Projects.

RECONNAISSANCES:
Ausable River,
Saranac River,
Chateaugay River,
Lake Champlain Region.

December 31, 1909.

MR. WALTER McCULLOH, *Consulting Engineer, State Water Supply Commission:*

DEAR SIR.— The following is the report of work in my division, season of 1909.

Briefly stated the work has consisted in filling in uncompleted topography around the Schroon Lake and Sacandaga reservoirs; the survey of State lands adjacent to those reservoirs and to Lake Pleasant, Lake Piseco and Blue Ridge, Schroon Lake and Chilson reservoir; borings at Tumblehead falls; and reconnaissances of the Boquet, Saranac, Ausable and Chateaugay river basins.

Topographic and Land Surveys.— The work of 1908 was done under pressure of endeavor to cover the reservoirs sufficiently to give at least a close approximation of their capacity and area and character of lands flooded. Many places were encountered where heavy timber or other causes prevented rapid work. Such places were left out in the 1908 work. Furthermore, the plotting of the 1908 work in the office, disclosed points at which it seemed desirable to obtain further development of the topography. Such places as these have been filled in during this season. There was an unfilled strip five miles long on the eastern shore of Schroon lake extending from Adirondack to the head of the lake. This is heavily timbered and required the work of one party about four weeks. The Schroon river was surveyed from its entrance into Schroon lake northerly to Schroon falls. Alder creek valley was surveyed from its mouth to a point two miles upstream. These two latter surveys kept one party at work fourteen days. Paradox lake was completely surveyed requiring one party forty days. Surveys in the vicinity of Pottersville required one party nine days. State lands on Paradox, Schroon and Chilson lakes, Schroon falls reservoir, Blue Ridge reservoir, Lake Pleasant, Lake Saranac, Lake Piseco and the Arietta flow were all investigated, requiring the work of two parties one month. The topography of several areas in the vicinity of Chestertown was filled in.

Borings at Tumblehead Falls.— In the late fall of 1908 a single hole on the south side of the river directly opposite the rocky promontory was put down forty-two feet without reaching ledge. The ledge outcrops jutting out into the stream from the north bank further down stream led to the belief that ledge could be encountered nearer the surface at that point and borings were undertaken to settle the question. They were begun August 18th. The contractor struck very difficult work and was losing money rapidly. Two very satisfactory holes were, however, completed to, and well into bed rock, after which, upon his request, the contractor was released.

The first hole is located about 400 feet east of the old hole and eight feet from the south bank of the river. Ledge was encountered at a depth of thirty-five and one-half feet from the surface or at elevation 742. The rock encountered is a hard and compact horn-blend gneiss. It was penetrated twelve and one-half feet. The second hole was located about fifty feet further upstream and across the road from the first. Ledge was found at a depth of forty-three and six-tenths feet and penetrated twenty-five feet. The covering to the ledge in both cases consists of boulders, sand and water-worn pebbles.

RECONNAISSANCES.

In accordance with your instructions the object kept prominently in mind in this work was to secure such a general survey of the streams as would form a basis for the direction of future detail surveys and for a general report upon the storage and power possibilities on the streams. Time and funds limited our work still further. It is believed, however, that the ground was covered sufficiently well to accomplish the main objects as stated above in a fairly satisfactory manner.

AUSABLE RIVER.

Present Developments.— From a little above Keeseville to Lake Champlain there is an available fall of 360 feet. Of this there is developed as shown by our power statistics a total of only 155 feet and a wheel capacity of only 4,662 horsepower. Near Rome there is a magnificent site for a dam 100 feet higher than that at present installed. These two examples show the haphazard and wasteful way in which these magnificent powers have been developed. This may be due to the division of ownership necessitating arbitrary divisions of fall and inability to build dams taking full advantage of the site, this inability being due to backing up of water on to other owners; or to development piecemeal only as needs called for new power; or to the fact that high head turbines have been available to American manufacturers for only about twenty years.

Of the total power of the stream practicable of development — 41,250 horsepower — only 6,446 horsepower is now developed, 4,600 at Keeseville, 1,500 at Rome and a few small powers at other places.

Keeseville Project.— The available fall from Keeseville to Lake Champlain using a dam seventy feet high at Keeseville is 360 feet. The drainage area is 476 square miles. With the Cherry Patch pond reservoir alone this area would yield a minimum regulated flow of 447 second feet with which a total of 13,800 horsepower at the wheel shafts would be available. This is an increase of 9,200 horsepower over the wheel capacity of the present plants, to say nothing of the portions of the year when the present plants are unable to run due to lack of water.

This project would involve a dam seventy feet high at Keeseville and a tunnel about eight feet in diameter, three and one-half miles long from Keeseville to Port Douglass on Lake Champlain. A rough estimate of the cost of a plant of this character up to and including the dynamos of 20,000 horsepower wheel capacity is $1,500,000 or $75 per horsepower. Besides this cost there would be land damages and purchase of water rights along the stream below Keeseville. This latter item would probably be very heavy. With the pondage created, 20,000 horsepower would probably be less than could be profitably developed. With the Indian Face reservoir in addition to the Cherry Patch pond reservoir, the minimum regulated flow would be 475 second-feet, and the power available 14,700 horsepower. Such a relatively small portion of the total fall is developed at present that a new method of development utilizing all the fall seems warranted. Further study of the degree of concentration of fall in the natural stream bed and of the costs of acquiring present rights would be necessary before the best method could be decided upon.

Clintonville Project.— This project would involve the building of a dam fifty feet high and 500 feet long at Clintonville. It would create a reservoir about two miles long and one-half mile wide. The fall obtainable by this dam and a penstock 1,700 feet long, would be sixty feet after allowing for a 20-foot fluctuation in head, and the pondage would be 0.3 billion cubic feet. The drainage area above this point is 450 square miles and a minimum regulated flow of 427 second-feet could be maintained by the storage proposed in the Cherry Patch pond reservoir. The power obtainable after deducting two feet loss in head between the dam and power house would be 2,250 continuous 24-hour horsepower. A penstock four feet in diameter would be required. There are two low dams located at Clintonville at present but only forty horsepower is developed under a head of ten feet.

Rome Project.— The James J. Rogers Company have a dam at this point thirty-four feet high furnishing a total fall of 100 feet on which they have a wheel capacity of 1,500 horsepower. This dam could readily be raised another 100 feet, the conditions being very favorable. The sides of the river gorge are almost vertical and the gorge is narrow. With the Cherry Patch pond reservoir and 200 feet of fall 4,500 horsepower could be developed with the extreme minimum flow of 250 second-feet from a drainage area of 230 square miles. Fifty-five hundred horsepower would not be too great a development for this site and as the pondage would be very great, any greater amount desirable in connection with the expected load curve could be developed. The development would cost comparatively little owing to the favorable conditions.

Wilmington Project.— A timber splash dam ten feet high has been maintained at Wilmington for over twenty years and is still used by the James J. Rogers Company in connection with their lumber operations for pulp wood for their mills near Ausable Forks. The foundations and topography would warrant a higher dam but only a slight increase would be possible without backing the water up against the tail water of the proposed Flume project. The river falls 102 feet in a distance of one and three-quarters miles. There is a large flat advantageously located at the power house site offering ample room for a power house or other works if desired. The best construction would probably be a pipe line on the hydraulic grade line for pond empty to a point near the power house site, thence steel pipe down the slope to the power house. The first part of the line would lie along a steep side hill ranging from one and one-half to two and one-half to one slope thus requiring considerable excavation or pier construction for pipe foundations. With the Cherry Patch pond reservoir mentioned below, a minmum regulated flow of 210 second-feet could probably be maintained, the drainage area being 139 square miles. With an available head of 95 feet 1,600 24-hour horsepower could be maintained throughout the driest year. Two thousand horsepower would be a conservative development on a 24-hour basis and a correspondingly larger amount for low load factors. Without the Cherry Patch pond reservoir the cost of this development would be too great for the amount of power available during the greater part of the time.

Flume Project.— This power site has recently been bought by the Paul Smith Electric Company. The dam will be founded on rock and have a height of fifteen feet. Above the dam site the valley opens out considerably thus offering considerable pondage.

The fall including the dam is 100 feet in one-quarter mile. The site for the power house is good. The power obtainable from a regulated flow is 1,900 minimum 24-hour constant horsepower and any amount in addition warranted by the expected load factor in connection with the pondage made available.

Wilmington Notch Project.— This project contemplates a canal, flume or pipe line from the Cherry Patch pond reservoir dam along the hydraulic grade line for reservoir empty, or slighty below, to a point four and one-quarter miles down stream and thence down the mountain side to the power house site one-half mile below. While this is the best development plan, State lands and variety of private ownerships may make some other scheme necessary. The fall would be 530 feet, reservoir empty, and 600 feet, reservoir full, or an average of say 550 feet. The speed of the wheels would be regulated for the 530 feet fall and loss of efficiency when running under the higher head would be very small. The drainage area would be about 118 square miles, if Owen brook be turned into the reservoir, the minimum regulated flow 175 second-feet and the probable power 8,100 horsepower. Nine thousand to 11,000 horsepower would not be too great a development. This development must, however, be studied in connection with the whole stream. The conditions are peculiar in that the fall at this point is nearly one-half that of the entire fall of the stream practicable of development. Careful studies will have to be made as to the best use of the stored waters. If the entire stream were to be developed by one party the best method of use would be a development at the dam site sufficient to (as nearly as practicable) use all the water as it becomes necessary to let it out for the best uses of the plants below. This power to be transmitted to the same lower plants to still further help out their low water powers. As water becomes more and more valuable this will undoubtedly be the method of use more nearly approached in the operation of storage reservoirs.

Cherry Patch Pond Reservoir.— The dam will be eighty-five feet high, about seventy feet long on the bottom and 600 feet on top. Foundations on the north side and in the stream bed are clearly on rock and it is believed that rock is near the surface on the south side also. From the foregoing statement of the power

Ausable River.
High Falls.

AUSABLE RIVER.
Dam site, proposed Cherry Patch Pond reservoir.

SARANAC RIVER.
Flowed lands in the vicinity of Lake Flower.

possibilities of the stream it appears that the stored waters of this reservoir would eventually be used on 1,305 feet of fall. The capacity will be approximately two billion cubic feet. If on the average, it be completely filled and emptied once each year this amount of water would yield 7,500 constant horsepower at ordinary efficiencies. When the development of power on a stream has reached a point where steam must be used as an auxiliary unless storage be used to help out the flow at low water, the value of the stored water is equal to the capitalized cost of an equivalent number of horsepower-hours of steam power. 65,700,000 horsepower-hours at one-half cent per horsepower hour amounts to $328,500, the yearly value of power derived from the stored water. Capitalized at 10 per cent. we have the value of the power as $3,285,000. This is the sum that could be spent for reservoir construction and power development when conditions are such that water power is worth the cost of its equivalent in steam power. At present prices for pulp and paper, the mills cannot produce profitably on steam power and in fact the above is an extreme figure although not so extreme as would render it immaterial, as regards power, where the plant be located; because the stored water is used to keep the plant running by wheels using for a great part of the year the ordinary flow of the stream. It is the value which the reservoir will have attained when the demand for power requires a production of auxiliary power by steam to the extent indicated, unless the storage reservoir be built. The dam and appurtenances will cost about $150,000. Land damages will be small, and this together with clearing and grubbing the area of 1,640 acres is taken at an average of $35 per acre. The total for this feature is $57,400 and the total cost of the reservoir $207,400.

State lands are involved at the west end of Connery pond, around Little Cherry Patch pond, and on the north side of Big Cherry Patch pond.

East Branch of the Ausable.—Proceeding upstream from Ausable Forks the practicable power projects are Jay, Keene-Jay, Keene and Beede.

Jay Project.—Here there is contemplated a dam twenty-five feet high, situated one-half mile above Jay, with pipe line starting at elevation 660 and running down the hydraulic grade line for pond empty to a point two and one-half miles downstream, thence down the mountain side to the river. A total fall of seventy feet is available with pond full. The drainage area is 165.8 square miles. With the Indian Face storage reservoir a regulated flow of 173 second-feet of water would be available at this point giving 900 horsepower. The water will be backed up by the proposed dam to the tail waters of the Keene-Jay project.

Keene-Jay Project.—This project contemplates a low diversion dam one and one-quarter miles below Keene and a flume about four and one-quarter miles in length along the hydraulic grade line or slightly below and thence down the mountain side to the power house site. The total fall is 135 feet, and the drainage area 135 square miles. The minimum regulated flow would be 148 second-feet, and the available minimum power, 1,500 horsepower.

Keene Project.—This project contemplates a dam 110 feet high. A considerable reservoir is thus created. Should the storage be used for regulation purposes the head at low water would be 175 feet gross. If used for local power the gross head would be 205 feet. A timber dam about nine feet high has recently been constructed about one-quarter mile above Keene, and a steel penstock is to convey water to wheels 500 to 700 feet downstream. The wheels are now being installed. The total head will probably not exceed twenty feet. The drainage area at the proposed dam site is eighty-nine and one-half square miles. The minimum regulated flow would be seventy-six second-feet, the minimum horsepower 1,140. With the Indian Face reservoir in addition to the pondage area provided, a minimum flow of 121 second-feet could be maintained, giving 1,800 horsepower minimum.

Indian Face Project.—This project is contemplated in connection with the Indian Face storage reservoir. The dam will be about eighty-five feet high, founded on rock. It will be about fifty feet long at the base and about 600 feet long on the top. From the dam there is contemplated a flume along the mountain side to a point opposite Beede, thence steel penstock to the power house three-quarters of a mile below Beede. The total fall available is 905 feet, reservoir full, or 865 feet, reservoir empty. The drainage area is twenty-five and seven-tenths square miles. A flow of fifty-two second-feet could be maintained, giving a minimum of 4,000 horsepower. Port Henry, seventeen miles distant, is the only place where any large amount of this power could be used to advantage. There are no transportation facilities nearer.

STORAGE RESERVOIRS, AUSABLE RIVER.—A study of the U. S. G. S. sheets showed possible sites as shown by the following table:

No.	NAME.	Capacity. *Billion Cu. Ft.*
1	North Elba	0.502
2	Chubb River	0.011
3	Lake Placid	0.524
4	Cherry Patch Pond	2.000
5	Indian Face	1.000
6	Keene Valley	.492
7	Styles Creek	.100
8	Jay	.290
9	Clintonville	.340

The North Elba reservoir is rendered less attractive by its comparatively small capacity and unfavorable dam site.

Chubb River site is almost too small for consideration in our work.

Lake Placid is controlled by a masonry dam built across the rocky outlet of the stream by the Lake Placid Shore Association. The entire dam is spillway and there is no outlet for water except over the top. It is the evident intention of the shore owners to keep the water at as constant a level as practicable. The surface of the lake does not as a rule fluctuate as much as a foot. These facts taken in connection with the small capacity of the reservoir, the length of dam required and the undoubted great opposition that would be stirred up by any disturbance of present conditions in the way of raising and lowering the lake, make the project unfeasible.

Cherry Patch Pond.—Practicable and described previously.

Indian Face.—The dam was described under the Indian Face project. Owing to the very great head which may be developed directly in connection with this reservoir, it would probably be best to regulate the flow for this power only, in which case the steadying effect on the plants down near the chasm would be comparatively little. Property rights on the lower lake ought to be small in value on account of there being but one small house at the foot of the lake, and of the fact that the shores are exceedingly steep, there being only here and there places where it is possible to land at all. On the upper lake there are several camps and the lake has a narrow margin. Considerable swamp land would be covered. No State lands are involved, the territory affected by the proposed reservoir, pipe lines and power sites being owned in toto by the Adirondack Mountain Reserve Society, except the swamp lands at the upper end of the upper lake, which are owned by Mr. Foote of Fort Henry. The society has built a fine gravel road from Beede, three miles up, to the foot of the lower lake. There is a low timber dam at the foot of the lower lake, but it is not used for anything except maintaining the level of the lake.

This reservoir would be very desirable on account of the power possible of development in immediate connection with it were it not for its being owned and used for a summer resort.

The other reservoirs mentioned in the above table are more in the nature of pondage than storage reservoirs proper, and are created incidentally to the power project.

TABLE I.

AUSABLE RIVER — PRACTICABLE DEVELOPMENTS.

No.	PROJECT.	Present development.	Drainage area.	Storage above reservoir.	Regulated flow.	Head.	Horse-power, 24-hr., 365-da.	Dam.			Flume length.	Penstock length.	Remarks.
								Height.	Length.	Fds.			
		Horse-power.	*Squ miles.*	*Billion cu. ft.*	*Second-feet.*	*Feet.*		*Feet.*	*Feet.*		*Miles.*		
1	Keeseville..........	4,600	476	*2.00	447	360	13,800	70	......	......	3½	......	Pressure tunnel.
2	Clintonville........	40	450	2.00	427	60	2,250	50	500	......	None	1,700 ft.	Pondage, 0.3 billion.
3	Rome..............	1,500	230	2.00	250	200	5,500	134	......	Rock	None	½ mile	Great pondage available.
4	Wilmington.........	None	139	2.00	210	95	1,600	10	150	Glacial drift	1½	600 ft.	Some pondage.
5	The Flume..........	None	130	2.00	200	100	1,900	15	150	Rock	None	½ mile	Considerable pondage
6	Wilmington Notch..	None	118	2.00	175	550	8,100	85	600	Rock	4½	½ mile	Storage, 2 billion.
7	Jay................	145	166	*1.00	173	70	900	25	......	Glacial	2½	400 ft.	
8	Keene-Jay..........	161	135	*1.00	148	135	1,500	8	......	Glacial	4½	650 ft.	
9	Keene..............	Some new	89.5	1.00	121	205	1,800	110	......	......	1½	1,350 ft.	
10	Indian Face*.......	None	26	1.00	52	865	4,000	85	600	Rock	3½	3,300 ft.	Storage, 1 billion.
		6,446	....	......	......	....	41,250						

*Although the Indian Face reservoir will add 30 to 40 sec. ft. to the minimum flow, it is not considered here as affording storage for the Keeseville project, because it is best used in connection with its own power. The reservoirs can be used to maintain a constant flow at but one point and this will cause some reduction to the figures given for powers at points other than the reservoir sites. Pondages will compensate for this loss in some cases and the figures are estimates for *minimum* flows instead of minimum for average year. These discrepancies may be considered compensating.

TABLE II.

AUSABLE RIVER — PROPOSED RESERVOIRS.

Areas and capacities based on maps of U. S. Geological Survey.

NAME OF RESERVOIR.	Catchment area.	Elevation of flow line above sea level.	Natural water surface.	Additional flowage.	State lands	Depth of water at dam.	Available storage.
	Square miles.	*Feet.*	*Acres.*	*Acres.*	*Acres.*	*Feet.*	*Billion cu. ft.*
Cherry Patch pond....	118	1,700	217	1,493	262	85	2.00
Indian Face..........	25.7	2,010	390	1,240	None	70	1.00
Keene Valley.........	89.5	1,000	......	......	None	90	.50

SARANAC RIVER.

Storage Reservoirs.—In considering storage reservoirs on the Saranac, careful consideration must be given to the uses of the lakes for summer residences. Some of the lakes will, for this reason, be left out of consideration, and the plans for the others will be materially modified by this primal consideration. Present conditions on Lake Flower, Miller pond and the lower end of Middle Saranac lake are, from a scenic and sanitary point of view, however, very bad. There are immense areas of unsightly swamp lands and flowed lands covered with dead and decaying trees and stumps. (See Photographs.) Middle Saranac lake is very shallow on its eastern and southern sides and there are great areas of reeds standing in the water. Conditions on the Upper Saranac would be greatly improved on the northeast shore by raising the water five to ten feet. On the west side of the Upper Saranac there are great swamp areas, but their relative elevations and other conditions are such as to make their complete elimination impracticable. Raising the lake to elevation 1,580 would render the ponds lying to the west accessible by steamer, and cover the large swamp area lying to the northeast of the lake. The resulting storage, if used in connection with that of the lower reservoirs, would furnish nearly sufficient storage to completely regulate the drainage area.

The run-off records of this watershed consist of deductions of run-off from the load curve of the Plattsburg Electric Company. For the period March, 1903, to January, 1908, the average run-off as thus deduced was 1.23 second-feet per square mile of drainage area. This covers a period of more than ordinary rainfall. The average run-off of the Hudson at Mechanicville for the 20-year period, 1888 to 1907, was 1.8 second-feet per square mile, and of the Raquette at Colton, 2.1 second-feet per square mile. Referring to Plate 22, 1909 report, the vertical line tangent to any curve gives the average yearly rate of run-off per square mile for that stream. None of the streams whose characteristics are there shown have so low an average rate of run-off. The rate of run-off of the Saranac ought to correspond fairly close to that of the Raquette, owing to the fact that their drainage areas adjoin in their upper regions, and they are quite similar in several important features. These facts throw grave suspicion upon the run-off records of the Saranac. On the other hand, the isohyetal lines on the map of the State show a smaller rainfall for the Saranac basin than for the Hudson and Raquette. Nevertheless it is believed that closer results for run-off can be obtained by using a characteristic curve lying between the curves of the Raquette at Colton and the Hudson at Spiers Falls, though this may result in some overestimate. More study is required before a decision can be made.

Saranac Lake Reservoirs.—A study of such data as we have made with the previously mentioned primal condition kept in view, leads to the following propositions for reservoirs on these lakes.

(a) *Lower Saranac Lake Reservoir.*— With a dam about three-quarters of a mile above Saranac Lake Village, raise the level above to elevation 1,544. This means a rise of seventeen feet over Lake Flower, Miller pond, Lonesome pond and the flowed lands of this region, a rise of 10 feet on Lower Saranac lake and the river above the State dam, and a rise of eight feet over Middle Saranac lake. Only the top eight feet of this storage is to be used for regulation, the elevation of water surface to be maintained not lower than at 1,540 from June 1st to September 15th, and never to be drawn below 1,536. This plan accomplishes the following purposes:

1. Covers swamp lands.
2. Covers unsightly flowed areas.
3. Opens up the entire region to good-sized steamer navigation during the navigation season.
4. Property destruction would be insignificant.

A proper consideration for the future use of these lakes for summer resort purposes requires the construction of this reservoir. Its use for regulation purposes without menacing the attainment of the other objects is practicable. The people of Saranac Lake village have for some time been agitating the cutting down of dead stumps in the flowed lands on account of their unsightliness and their menace to boating and navigation. According to an article in a local paper, the village board of trade has been agitating for the work of removing dead timber. Costs were to be met by popular subscription.

The dam site is a fairly good one and indications are that at least part of the dam may be founded on rock. A section at the dam site accompanies this report.

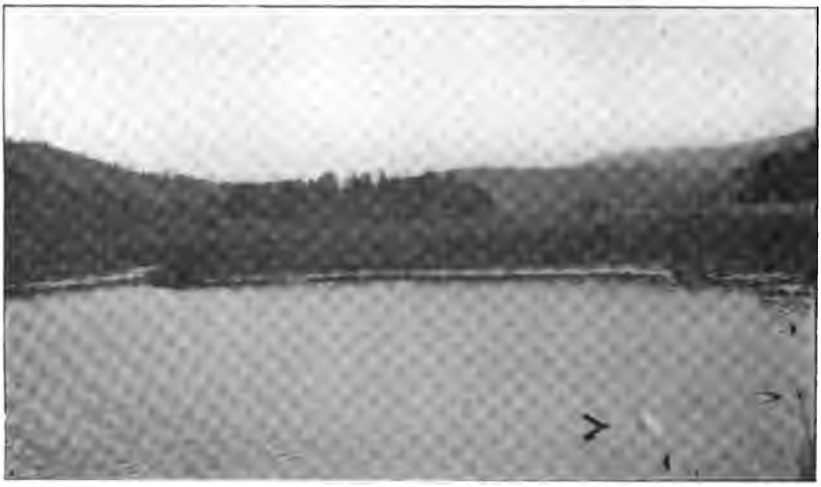
The available storage furnished by the project as above outlined will be two and eight-tenths billion cubic feet.

(b) *Upper Saranac Reservoir.*— As a preliminary, the elevation of water surface for the reservoir is chosen at elevation 1,580 (nine-foot rise). The dam would be founded on rock. There would probably be considerable property damages as there are a large number of expensive camps, though for the most part they are well above the lake. The storage would be three and two-tenths billion cubic feet.

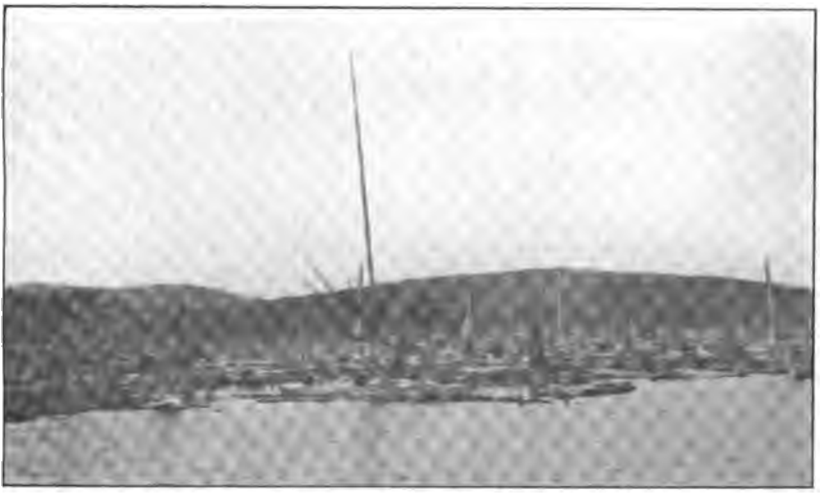
(c) *Pyramid Rapids Reservoir.*— This is another fairly good reservoir site extending from Saranac Lake village downstream to Pyramid rapids, a distance of ten miles. The area thus flooded would be practically all swamp. The reservoir is not needed, however, in connection with the two Saranac Lake reservoirs, and to obtain any considerable storage, it would be necessary to flood back against the power at Saranac Lake village and cover some of the business portion of the town.

(d) *Franklin Falls.*—The dam at present in place, built by the Paul Smith Company for power purposes, will impound 0.25 billion cubic feet. Twenty-six acres of State lands are flooded, however, and the plant has never been completed on that account. The capacity of this reservoir will be useful mainly as pondage for the proposed plant in connection therewith.

(e) *Union Falls.*—The storage at this dam is estimated at 0.6 billion cubic feet, but all of it cannot now be used on account



SARANAC RIVER.
Swamp lands between Lake Flower and Lower Saranac lake.



SARANAC RIVER.
Flowed lands in the vicinity of Flower lake.

Saranac River.
High Falls.

Saranac River.
Flowed lands in the vicinity of Flower lake.

of the flooding of some thirteen acres of State land. This storage, also, is useful mainly as pondage for the attached plant.

North Branch Saranac River.— The practicable storage sites on this stream are so surrounded by summer cottages that when considered in connection with their comparatively small size and limited use, it does not seem desirable to disturb present conditions.

POWER PROJECTS ON THE SARANAC.

Franklin Falls.— A concrete dam, power house and tail race have been built here, but on account of the flooding of State lands, the penstock and machinery have not been installed. The total head is fifty-four feet, and with the thirty and seven-tenths square miles of drainage area regulated by the six billions of cubic feet from the two Saranac Lakes reservoirs, a minimum flow of 497 second-feet could be maintained, giving 2,350 horsepower.

Union Falls.— A concrete dam, steel penstock eleven feet in diameter and 1,500 feet long, and concrete block power house have been built, and one unit of 1,800 horse-power installed, with provision at the power house for doubling the water wheel and dynamo. The head is fifty-nine feet total, and the drainage area 336 square miles. With storage of six billions, a minimum regulated flow of 525 second-feet should be maintained, giving 2,770 horsepower.

Tefft Pond.— This project would involve the reconstruction of the old dam or the building of a new one at the outlet of Tefft pond, and a canal or pipe line five and one-half miles long to a point one-half mile below the village of Redford. The total head would be 300 feet.

The drainage area at this point is 352 square miles, and with the proposed storage of 6 billion cubic feet, a regulated flow of 545 second-feet could be maintained, producing 13,400 continuous 24-hour horsepower. Although the pipe line would be very long, the resulting power is large and there being no great concentration of fall nor suitable high dam sites at any point, the power cannot be developed in any other way.

High Falls.— This portion of the Saranac river offers an excellent opportunity for a power development. The drainage area above this point is 518 square miles, and a minimum regulated flow of 695 second-feet could be maintained.

The project would involve the construction of a dam forty-seven feet high on rock foundations. It would be about forty feet long at the bottom and 150 feet long at the top. A flume, penstock or pressure tunnel 2,600 feet long would also be required. A head of 240 feet would be obtained in this manner. Fifteen thousand 24-hour continuous horsepower can be developed.

The pondage would be very small, but as the distance to the Saranac regulating reservoirs is only thirty-two miles, this would not prove a serious disadvantage. The site is now owned by the International Paper Company, who use a large part of the power now developed on the river below, and will probably be developed by them as soon as there is a market for the power.

Saranac Village.— There are two dams located near the village of Saranac. The upper one has been abandoned and is falling into decay. The lower dam is used to furnish power under thirteen-feet head to a feed and lumber mill using 228 horsepower.

Much improvement would not be practicable in this vicinity, due to the small head which is available. The present small power would of course be greatly benefited by river regulation. The drainage area is 540 square miles, and with a minimum regulated flow of 707 second-feet, 770 continuous 24-hour horsepower could be developed, or an increase of 542 horsepower over that developed at present.

Cadyville Project.— In the vicinity of Cadyville are located four dams of the International Paper Company. These dams are known on the company's records as "New Dam," Mill B, Mill C, and Mill D dams respectively, named in the order going downstream. Mill D is also known as Kent's Falls mill.

"New Dam" is at present used for storage purposes only, and impounds about two-tenths billion cubic feet. Mill B is an old development of 1,070 horsepower, and contains only two stones for the grinding of pulpwood. By using "New Dam" and building a penstock about 1,000 feet long to Mill B a head of seventy-five feet could be obtained. This would necessitate the abandonment of Mill B and the construction of a modern mill or power house in its stead.

The drainage area at this point is 598 square miles, and a minimum regulated flow of 748 second-feet could be maintained, which would produce 19,700 continuous 24-hour horsepower with the head available at the three dams. The changing of "New Dam" from a storage dam to a power dam would entail very little expense, as it is equipped with gates and pipe connection for that purpose. The storage advantage lost at this dam by the change would be insignificant as compared with the storage proposed on the upper part of the river, which would give far better regulation for all the developments located along the entire stream.

No changes should be proposed at either Mill C or Mill D, both of which are modern mills used for the grinding of pulp wood. At Mill C, 5,800 horsepower is now developed under a head of sixty-six feet and at Mill D 3,978 horsepower under a head of 156 feet.

Both Mill C and Mill D are equipped with wood burning steam auxiliary plants of 150 horsepower capacity each, but even with the use of this auxiliary power they were compelled to run at a small part of their maximum output during the dry weather of 1908 and 1909.

Morrisonville.— At Purdy's Mill near Morrisonville, there is located an old timber dam from which ten feet head is obtained and used in developing 150 horsepower used at Purdy's saw mill and 75 horsepower used at a grist mill and creamery on the opposite side of the river. From Mill D of the International Paper Company near Cadyville to Purdy's mill there is an undeveloped fall in the river of 140 feet in a distance of one and three-quarter miles. By the construction of a low diversion dam below the tail race of Mill D and a canal or pipe line one and three-quarter miles long a new power development of considerable value might be created. The drainage area for this project is 598 square miles from which a minimum regulated flow of 748 second-feet might be expected. Eight thousand eight hundred and forty continuous 24-hour horsepower could be developed.

Vicinity of Plattsburg.—Between Purdy's mill, which is about eight and one-half miles up the river from Plattsburg, and the point where the river flows into Lake Champlain there is a fall of 180 feet. Practically this entire fall is now developed by means of seven dams, most of which are old timber structure and some of which might be raised small amounts as it becomes necessary to repair or replace them. The only benefit which could be afforded the power users in this vicinity would be an increased minimum flow of the river by means of the proposed storage reservoirs. There is now developed on this part of the river according to our water power census 9,880 horsepower. The drainage area at the mouth of the river as given in Rafter's Hydrology of the State of New York is 628 square miles. From this area a minimum regulated flow of 779 second-feet may be expected.

The total net head available in this vicinity after deducting the probable losses from the gross head of 180 feet would be about 130 feet. This would develop 9,200 continuous 24-hour horsepower with the probable minimum regulated flow.

TABLE III.

SARANAC RIVER — PRACTICABLE DEVELOPMENTS.

No.	PROJECT.	Present development.	Drainage area.	Storage above.	Regulated flow.	Head.	Horsepower.	ELEMENTS.				Penstock length.	Remarks.
								DAM			Flume length.		
								Height.	Length.	Fds.			
		Horsepower.	*Square miles.*	*Billion cu. ft.*	*Second-feet.*	*Feet.*		*Feet.*	*Feet.*		*Miles.*	*Feet.*	
1	Upper Saranac lake reservoir..........	None	77	3.2	......	....	......	9	400	......	None	None	Storage only.
2	Lower Saranac lake reservoir..........	646	184	6.0	342	11	310	27	350	Some rock	None	......	New dam for storage only; power developed at old dam.
3	Pyramid Rapids reservoir...........	None	....	......	......	....	......	......	......	......	......	......	Not needed in connection with other reservoirs.
4	Franklin Falls......	None	307	6.0	497	54	2,350	New concrete dam now built..................			None	......	
5	Union Falls........	1,800	336	6.0	525	59	2,770	New concrete dam now built..................			......	Now built	Can install another 1,800-horsepower unit.
6	Tefft pond.........	None	352	6.0	545	300	13,400	Present dam might be repaired..................			5½	......	
7	High Falls.........	None	518	6.0	695	240	15,000	47	150	Ledge rock	None	2,600	Small pondage.
8	Saranac village.....	228	540	6.0	707	13	770	No new work required.			......	......	
9	Cadyville..........	10,848	593	6.0	746	75 156 66	19,700	3 concrete dams now built			None	1,000	
10	Morrisonville.......	225	598	6.0	748	180	8,840	About 8	200	......	1¼	......	
11	Vicinity of Plattsburg............	9,880	628	6.0	779	180	9,200	No new work.			......	......	
		23,627	....	......	......	....	72,340						

TABLE IV.

SARANAC RIVER — PROPOSED RESERVOIRS.

NAME OF RESERVOIR.	Catchment area.	Elevation of flow line above sea level.	Natural water surface.	Additional flowage.	State lands.	Depth of water at dam.	Available storage.
	Square miles.	*Feet.*	*Acres.*	*Acres.*	*Acres.*	*Feet.*	*Billion cu. ft.*
Upper Saranac lake...	76.9	1,580	6,640	3,946	2,782	9	3.2
Lower Saranac lake...	189.0	1,544	4,850	5,820	3,680	17	2.8
Franklin Falls........	......	......	58	198	26	......	*0.25
Union Falls..........	336.5	......	160	902	13	......	*0.60

* Dams are now constructed but cannot be filled on account of flooding State lands. These reservoirs will be used for pondage in connection with their attached powers only.

CHATEAUGAY RIVER.

The time allotted for the reconnaissance of this stream was curtailed by bad weather. It is believed, however, that a fairly good idea of conditions and possibilities was obtained.

Upper and Lower Chateaugay lakes are connected by a narrow arm of water known as the Narrows. They are at practically the same elevation. The area of the two lakes and the Narrows is seven square miles as planimetered from the U. S. G. S. Postal map. The drainage area at the outlet of the lower lake is 91 square miles as planimetered from the same map. At Chateaugay, the center of gravity of the power district, the drainage area is 112 square miles. At the Canadian boundary it is 163 square miles. From the lakes to the Canadian boundary, a distance of thirteen miles, there is a fall in the river of 990 feet as determined by barometer readings, but they may be in considerable error as the readings were taken under unfavorable weather conditions. Nine hundred and ninety feet is believed to be quite accurate, however, as it agrees very well with the total fall said, by one of the power owners, to exist in the river between these points. Our water power census shows 347 feet of this fall under development at present with a horsepower of 5,508. Practically the entire fall of the river in this State is now owned by parties interested in power development projects. Better regulation of the flow of the river which could easily be obtained by building a dam at the outlet of the lower lake would be of much benefit to all these power users.

By raising the water level of the lakes sixteen feet which could be done by means of a dam about 150 feet long, a storage of four billion cubic feet would be created. This would give a minimum regulated flow of 210 second-feet or thirty-six million cubic feet per square mile of drainage area at the village of Chateaugay. This would probably give the maximum economical regulation which could be effected at this point. No State land would be flooded by this reservoir. The upper lake is used to quite an extent as a summer resort and the lower lake to a less extent. Care is taken by the power plants at present not to draw the lake more than about three feet. Twenty-three cottages, hotels, etc., fifteen boathouses of small value and one cemetery would be flooded.

*TABLE SHOWING WATER POWERS BENEFITTED BY STORAGE PROPOSED AT CHATEAUGAY LAKE RESERVOIR.

No.	LOCATION.	Drainage area.	Storage above.	Regulated flow.	Fall.	Horsepower.	Remarks.
		Square miles.	*Billion cu. ft.*	*Second-feet.*	*Feet.*		
1	Forge	94	4.0	183	35	550	
2	Hoy	98	4.0	190	50	820	
3	Chase	106	4.0	202	100	1,740	
4	Leary	113	4.0	213	88	1,620	
5	Johnson Pulp Co	121	4.0	223	100	1,930	
6	Between No. 5 and No. 7	126	4.0	230	60	1,190	
7	High Falls Pulp and Paper Co	135	4.0	245	115	2,430	
8	Hogs Back	138	4.0	248	36	770	
9	Johnson Pulp and Paper Co	139	4.0	250	12	235	
10	Douglas	140	4.0	252	18	390	
11	Adirondack Developing Co	146	4.0	258	70	1,560	
12	Chasm Power Co	153	4.0	270	87	2,030	
13	Perry's Co	163	4.0	282	115	2,800	
						*18,065	

* Five thousand five hundred and eight horsepower is developed on the river at present.

CHAZY RIVER.

Chazy lake was visited with a view of using it as a reservoir for storing water for the considerable fall in the south branch of the Chazy. It was found, however, that there is no dam site and that the drainage area would warrant a capacity of only five-tenths billion cubic feet. Hence it was concluded that the stream was not of sufficient magnitude to warrant attention from the State.

BOUQUET RIVER.

This river was given considerable study on the U. S. G. S. sheets and some points visited in the field, from which it was concluded that there are no projects either for storage or power of sufficient magnitude to be worthy of action on the part of the State.

LAKE GEORGE OUTLET.

Lake George outlet has, at the foot of Lake George, a watershed of about 220 square miles, of which Lake George covers forty-three square miles. The fall from Lake George to Lake Champlain is about 220 feet and the entire height is utilized as far as is practicable in five stages. The total wheel power installed at present in the five stages is 8,080 horsepower but as at present regulated there is sufficient flow for all these wheels during only about two months of the year.

The regulation of the flow is accomplished by a concrete dam with spillway eighty-three feet long and waste gates. The limits between which the dam is effective for storage are very small, it being permitted to raise the water eight inches above the crest with flashboards and to lower the water below the crest about thitry inches after closing of navigation. During the season of navigation the water is held close to the crest of the dam. It is thus seen that operation of the storage is very circumscribed. As a result the works are shut down or run by steam auxiliary in whole or in part during a great part of the year. In the case of the pulp manufacturers, they claim that with present prices pulp cannot be ground profitably by steam. The International plants, therefore, have only a small fraction of steam auxiliary power and close as the water falls off. The Ticonderoga Pulp & Paper Company have steam auxiliary to the extent of about half their water wheel capacity.

The power users on the stream are alive to their needs and, it is believed, secure as great use of the waters as is economically practicable.

SUMMARY OF RECONNAISSANCE OF AUSABLE, SARANAC AND CHATEAUGAY.

The large number of natural powers existing on these rivers but left undeveloped by their owners leads to the conclusion that a market does not now exist for the use of the power. In most cases the power sites are in the hands of men who are themselves manufacturers and users of power and it would appear that if a market existed they would know of it and supply it at least to the extent of the power that they could easily develop. As a matter of fact, the large users of power all through the Adirondack region are the pulp and paper makers depending largely for their supplies of wood upon their holdings of timber in the vicinity and they see the exhaustion of these holdings in the near future not more than fifteen to twenty years away. They reason, therefore, that it is not good business policy to develop more power when their present developments will be out of business for want of material in a comparatively short period and they will then have to look for new uses for the old power. The present attitude of Canada as to exportation of pulp wood also has an important bearing.

That there will be a market for all this power in the near future cannot, however, be doubted when one considers the rapidity of past growth of water power development in New York State. A proper study of the possibilities will hasten the production of such a market and can be completed in all its details none too soon to meet the probable demand.

From the foregoing it appears that owing to the present use of the lakes on these basins as summer resorts, there are many cases where, although storage reservoirs could be built, it would be inadvisable to do so, while in some other cases the full value of the lakes as summer resorts cannot be obtained without raising the lakes; that there are very great storage and power possibilities, but that the market for power in this region has not been developed to a point where the natural falls and flow of the stream are fully used, although there is considerable activity being displayed in getting possession of the favorable sites; that the ultimate practicable power is enormous, and the streams may well be included in the plan of the Commission.

FUTURE WORK ON THE EASTERN DIVISION

If the Commission recommends the Sacandaga project for the first construction, much remains to be done to put the maps and plans on a contract-letting basis. The 1908 and 1909 reports recognize this and recommend the expenditure of $10,000 for borings. I think this sum might prove inadequate although, on the other hand, fortunate early findings might make it more than sufficient.

The previous reports also clearly point out the fact that the plans heretofore developed are merely preliminary. They should be gone over carefully this winter, places where more information in the field is required noted and new plans developed as far as practicable on a contract-letting basis. The site from which the material is to be taken for the dam should be examined thoroughly by test pits, and an experimental study made of the suitability of the material for use. Methods of construction should be studied. Hydraulic sluicing is mentioned in the previous reports as a possible method of construction. Water supply for the work should be studied and comparative estimates made of cost by hydraulic methods and steam shovel and cars.

A final relocation of the portion of the F. J. & G. Railroad to be reconstructed should be made.

Land maps should be begun and prosecuted with vigor in order that the purchase of the lands required may be given plenty of time and attention by those competent to handle the matter.

The commercial aspects of the enterprise need much more study. The exact conditions at each fall and plant should be obtained and in the light of all this data and that previously obtained, detailed studies of the commercial aspects of the project should be made.

The foregoing report of the reconnaissance of the Ausable, Saranac and Chateaugay rivers show the great present and rapidly increasing importance of these streams as power producers. A detailed study of the reservoirs and powers along the lines indicated by this report is recommended as necessary to a consideration of the proper steps that should be taken by the State to conserve as much of its interests therein as practicable.

Very respectfully submitted,

A. H. PERKINS,
Resident Engineer.

IV.

RFPORT OF ERWIN E. HASLAM, RESIDENT ENGINEER.

Surveys and Investigations, Raquette River.

December 31, 1909.

Mr. Walter McCulloh, *Consulting Engineer, Albany, N. Y.:*

Dear Sir.— I have the honor to submit the following report covering the work under my direction on the Northern Division during the year ending December 31, 1909.

I reported for duty at Albany on May 17, 1909, and was immediately assigned to the Northern Division with headquarters at Tupper Lake village, Franklin county, N. Y.

The field work for the season, including about 110 miles of stadia traverse on flow line topography, twenty-six miles of accurate levels and an extension of the triangulation system, consisted mainly as follows:

(1) Surveys and hydraulic investigations relating to the proposed Setting Pole dam in the Raquette river.

(2) A survey to locate the State land in proposed reservoir sites in the Raquette watershed above Raquette falls.

(3) A topographical survey of the Little Tupper-Round lake project including the district in the vicinity of the Slim ponds.

(4) A complete survey for alternative hydro-electric developments on the Little Tupper outlet from Round lake to the junction with the Bog river.

(5) Surveys for alternative dam sites below Tupper Lake village for the Tupper lake project.

Levels.

During the season of 1908 and 1909, 136 bench marks have been established throughout the various reservoir sites from Raquette lake outlet to South Colton, a distance of about ninety-five miles. The difference in elevation on check runs between bench marks was within the limit of .02 feet × $\sqrt{\text{distance in miles}}$.

Twenty-six miles of single rodded levels were run during 1909 from the head of Raquette falls to Long lake, Buttermilk falls, Forked lake and Raquette lake outlet, checking the United States Geological Survey bench marks and establishing fourteen new bench marks.

The U. S. G. S. benches along Long lake were checked from the water surface of the lake and several bench marks were established along the east shore of Long lake at points convenient for the topographical parties. From the head of Long lake the line was run along the Raquette river to Forked lake, establishing two bench marks at Buttermilk falls (one below and one above) and checking the U. S. G. S. bench mark at the forks of the road above Buttermilk falls. The water surface of Forked lake was used to transfer our levels to the carry road between Raquette and Forked lakes. A bench mark was established at the Forked lake end of the carry and a line of levels run to the government bench mark at the crossroads on the carry to Raquette lake.

TRIANGULATION.

The entire stadia work for the seasons of 1908 and 1909 has been tied into the United States Geological and the New York State Land Surveys by a triangulation system composed of a network of sixty-three secondary triangulation stations, inclosing a territory of about 290 square miles.

The main object of this triangulation system is to enable us to join all of the surveys made in the Raquette river watershed with those made by the U. S. Government and the New York State Land Surveys, for the purpose of an accurate comparison of the lines of the several parcels of State land that exist throughout this portion of the forest preserve.

The triangulation can be extended under one system of co-ordinates throughout the entire area of the Raquette river watershed within the limits of the several storage projects, which will permit the plotting of the entire or portions of the area covered by surveys on any map without changing the co-ordinate system.

On the Tupper lake project during the season of 1908, thirty-three triangulation stations were established and a base line was measured with a probable error in measurement of 1 in 140,000. During 1909 there were fifteen triangulation stations established on the Long lake project, using the distance as computed by the U. S. Geological Survey between Mount Morris and Mount Seward as a base line. On the Little Tupper project the U. S. Geological Survey distance from Mount Morris to Mount Arab was used as a base line, and fifteen triangulation stations were established.

SETTING POLE DAM.

As the village of Tupper Lake, under an act of the Legislature known as chapter 284, Laws 1909, had petitioned the State Water Supply Commission to assume jurisdiction over the proposed improvement in the Raquette river at the Setting Pole rapids between the villages of Tupper Lake and Piercefield, I proceeded, in accordance with your instructions, to make the necessary surveys and to collect data for a report on the proposition of building a new dam at Setting Pole rapids.

In order to show the actual location of the property belonging to private individuals, in accordance with the old original land surveys in the vicinity of the proposed dam, our surveys were tied on to the St. Lawrence–Franklin county line, which crosses the Raquette river about 1,400 feet below the site of the proposed dam.

The field work consisted mainly as follows:

1. A topographical survey of the new dam site adjacent to the present dam in sufficient detail for the design of a new dam and the computation of quantities for the letting of contracts.
2. An investigation of the present dam relative to its condition and availability for use as a coffer dam during the construction of the new dam.
3. Accurate soundings were taken at regular intervals of ten feet across the entire width of the river, and on parallel lines spaced twenty feet apart for the distance of 200 feet above and below the center line of the proposed dam. Several borings were made to locate the ledge foundation.
4. A study of the hydraulic conditions of the Raquette river from Raquette falls to Piercefield, from flood to ordinary stages,

together with the probable effect due to backwater on the localities above the new dam, if it were constructed with a crest five feet above the top of the existing dam.

5. A complete topographic survey was made around the shores of Raquette pond in the vicinity of Tupper Lake village and Tupper Lake Junction, and the same plotted on a scale of 100 feet to 1 inch.

The above-mentioned investigation was made to secure data for the consideration by the Commission of the plans and estimates when they should be prepared by the village engineer, and submitted by the board of trustees of the village of Tupper Lake. The plans of the village engineer were filed on July 19th, and called for a solid concrete masonry dam with a crest at elevation 1543.3, provision being made for flashboards.

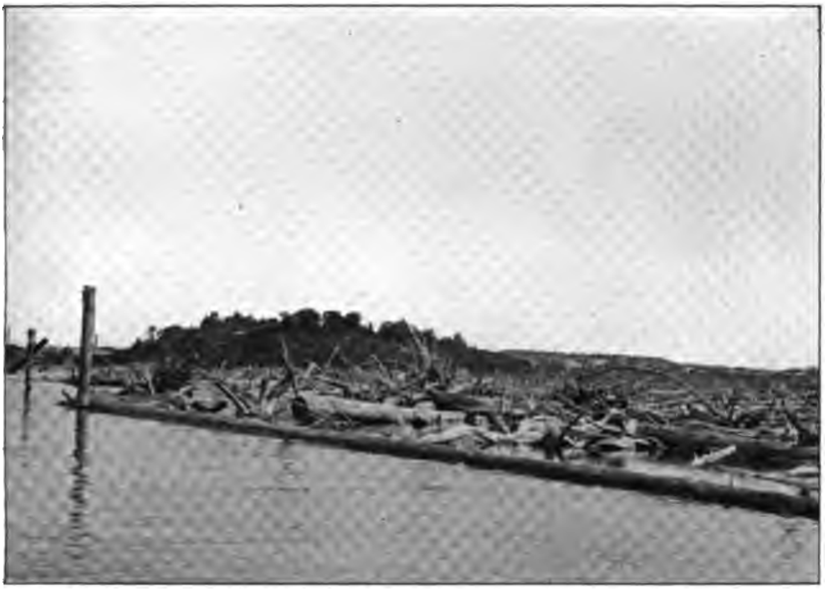
Under my direction, a design and estimate of cost for a dam entirely independent and without any knowledge of the village engineer's plans and estimates were prepared and submitted on August 6th. In order to properly control the spring freshets, and based on the study made of the hydraulic conditions of the Raquette river, the design provided for two spillways, a log run and five steel sluice gates of the latest approved Tainter type controlling openings twenty feet wide, sufficient to take care of the ordinary flood of the Raquette river.

STATE LAND SURVEYS.

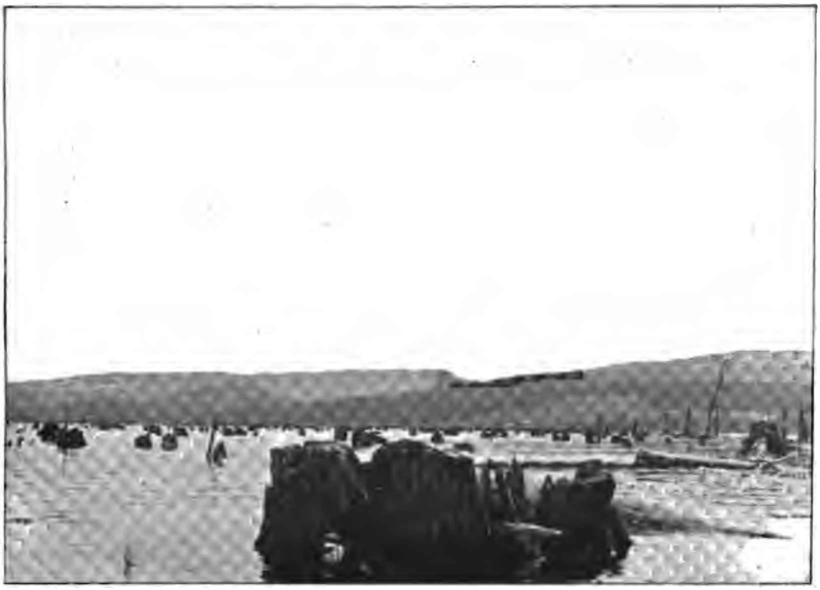
The field work on the location of the State land in the watershed of the Raquette above Raquette falls began June 28th. The object of this survey was to locate accurately the important corners of the principal subdivisions of State land in the several townships within the zone affected by the storage reservoirs.

Neither time nor funds were available for tracing out each separate boundary of the subdivisions of the State land, in fact, this would not be feasible nor practicable in districts devastated by forest fires and in the dense undergrowth of the swamps, but all principal boundaries were carefully located.

The flow line of the proposed Long lake project was run from Raquette falls up Calkins creek and Cold river and thence to



Raquette Pond — Above Dam Site No 1.
Stump lands exposed during low water in the summer.



Big Tupper Lake — Low Water.
Condition at the foot of the lake — A menace to navigation and pleasure boating.

Long lake, with the object of determining the taking line on the State land. The boundaries of State land were located within the area of land required for storage purposes.

The south boundary of St. Lawrence and Franklin counties and the north boundary of Hamilton county were established by the State Engineer and Surveyor in the year 1904, and accurately marked by iron monuments set in concrete, which are referred to a straight base line which has likewise been permanently marked by monuments.

These county and base line monuments from the Little Tupper outlet to the Essex county line were tied into our triangulation system by stadia surveys. This was done in order to establish, without question, the location of the several township lines joining on the county line. The township lines crossing Long lake were also tied in accurately by triangulation, and all subdivisions of the separate parcels of State land affected by storage similarly located. The field work was tied into the surveys of Townships 6, 34, 35 and 40 made by Mr. D. C. Wood for the Forest, Fish and Game Commission at the line between Townships 21 and 35, Totten and Crossfield purchase.

During the surveys of 1908, the county line between St. Lawrence and Franklin counties was located from the north side of Lot 24, Township 6, St. Lawrence county, to the north side of Lot 14, Township 3, and tied into our triangulation system. The line between Townships 22, 25, 23 and 26, together with the corner of the four townships, above mentioned, was also accurately located, as shown by monuments, plugs and post corners, found in the field. In Township 23, the north side of the private tract north of Township 26, in the vicinity of the Spectacle ponds was also located.

The results of these surveys were compared with the map published by the Forest, Fish and Game Commission in 1908 on which the several parcels of State land are shown.

The following table shows the amount of State land required for storage reservoirs within the Raquette watershed. The " taking line " upon which the estimates are based is about eight to ten feet higher in elevation than the proposed flow line, and, in general, follows the contour of the ground at this elevation, eliminating the minute indentations of the topography.

TABLE I.

STATE LAND REQUIRED FOR STORAGE RESERVOIRS IN THE RAQUETTE RIVER WATERSHED.

PROJECT.	Location of dam.	Flow line.	Taking line.	Swamp.	Waste and burned.	Timber land.	Total.
				acres.	*acres.*	*acres.*	*acres.*
Tupper lake...	Tupper lake village............	1,575	1,580	2,770	455	1,800	5,025
Long lake.....	Raquette Falls....	1,635	1,640–1,645	315	605	460	1,380
Forked lake...	Foot Forked lake..	1,762	1,770	750	.....	280	1,030
Raquette lake.	Foot Raquette lake	1,765	1,770–1,775	3,195	.....	765	3,960
Blue Mountain lake........	Foot Utowana lake	1,794	1,800	15	.....	10	25
				7,045	1,060	3,315	11,420

HYDROGRAPHIC SURVEYS.

During 1908 and 1909, the slope of the Raquette river from Raquette falls to Piercefield has been obtained from flood to ordinary conditions by water surface gages established at critical points along the river; the changes in stage of the various lakes have been recorded, and water surface readings have been taken of Big Tupper lake and Raquette pond daily from June 10 to December 5, 1908, and May 17 to December 15, 1909. All the gages were referred to the bench marks determined by accurate levels run during the seasons of 1908 and 1909.

A complete list of the gages is shown in the following table:

TABLE II.

LOCATION OF GAGES FROM PIERCEFIELD TO FORKED LAKE.

LOCATION OF GAGE.	Miles from Pierce-field gage.	Readings taken from.
Piercefield U. S. G. S. gage	0.	Graduated gage.
Piercefield highway bridge (above)	0.65	Graduated gage.
St. Lawrence-Franklin county line	1.93	
Setting Pole dam below	2.20	Nail on crib.
Setting Pole dam above	2.24	Graduated gage.
N. Y. C. R. R. bridge below	3.75	Concrete wall.
N. Y. C. R. R. bridge above	3.77	Graduated gage.
Tupper Lake village dock	5.39	Graduated gage.
Bridge Moody village	9.17	Iron pier.
Bridge Le Boeuff's	11.63	Spike on bridge.
Bridge Snell's	13.73	Spike on bridge.
Brooklyn Cooperage Co. landing	16.56	From B. M.
Follensby Pond Dam	20.22	Sill of spillway.
Axton	23.81	Graduated gage.
Bullhead rock	28.94	Graduated gage.
Raquette falls foot of carry	29.72	From B. M.
Raquette falls U. S. G. S. gage	30.47	Graduated gage.
Raquette falls head of carry	30.60	From B. M.
Franklin-Hamilton county line	32.81	
Long Lake foot of Hosley's dock	36.28	Graduated gage.
Long Lake village, Sullivan's dock	45.63	Graduated gage.
Forked Lake foot Hosley's camp	54.03	Graduated gage.

The gage records enable us to compute the total supply and natural storage of these lakes which are important factors in controlling the discharge of the Raquette river at Piercefield in connection with the regulation contemplated by the construction of the auxiliary storage reservoirs of Little Tupper, Long and Forked lakes.

When the water in a lake is rising, the lake is holding back a portion of the run-off, which decreases the natural discharge of the river during this period of time. When the flood season has passed and the lake begins to fall, it adds to the natural run-off that would occur if there were no lake in the watershed. Nature has provided a natural system of storage reservoirs in the Raquette watershed. All of the lakes throughout the system have shallow outlets. During the early winter months these outlets are covered with ice which decreases their cross-section and causes a reduction in the flow, thus raising the water surface of the lake. The natural storage due to the ice begins usually early in November, resulting in the gradual filling of the lake until the ice covering is removed in the spring; however, this natural storage on the Raquette watershed during the winter months does not conserve the water from the practical standpoint.

(1) Because the storage due to ice decreases the discharge of the stream during the low water conditions of the winter months.

(2) As the lakes are nearly full when the spring floods occur they cannot exert the maximum effect for flood regulation that would be afforded by an empty basin.

The gage records have an additional value in making a start toward collecting the hydraulic information that will be indispensable for proper operation of the controlling works, when the smaller storage reservoir projects on the Raquette are constructed and under operation before the main project on Big Tupper lake, as it would be necessary to know the amount to be yielded or retarded by the upper natural reservoirs, *in advance* of the decreased or increased supply, in order to control the storage for efficient regulation.

Observations of the water surface were made to determine the changes in the slope of the Raquette river from Piercefield to Raquette falls from flood to ordinary stages. This information is very important inasmuch as from the data obtained we are in a position to compute the backwater curve that would occur for changes in the level of Raquette pond or Tupper lake. All of these records can be referred to the U. S. G. S. gages at Piercefield, Raquette falls and Bog river. The complete report upon this data is not possible at present, as it is necessary to make the calculations from the observations in order to establish the relation between the gages for the same stages of the main controlling gage at Piercefield.

EVAPORATION.

One of the most important problems that will have to be solved for the operation of the large reservoirs for storage purposes is the proper determination of the loss by evaporation. At the present time this question cannot be answered at all, for we do not even know accurately the loss by evaporation from reservoirs already in operation. Loss by evaporation results in a loss in mechanical power throughout the entire length of the Raquette river below Piercefield.

It is essential, therefore, that this percentage of loss by evaporation should be well known in order to estimate accurately the quantity of water that the State can guarantee to the power users and also to determine the proper method of operation at the controlling works at the several reservoirs of the storage system.

The meteorological factors that influence evaporation being beyond human control only make it the more imperative that we observe the conditions which these factors produce in order that the maximum conservation of the water for storage purposes may be maintained. The selection of the height to which the water might be raised, or to which the water might be drawn, would be influenced by the rate of evaporation.

Although rapid strides are being made in the perfection of self-recording apparatus for the measurement of evaporation, such information is being collected where the existing meteorological conditions are entirely different from those that exist in the Adirondacks, so that if a certain number of inches are evaporated from a reservoir in one portion of the United States, it is not safe to predict that a similar or proportional amount would be evaporated in the Adirondacks.

The entire subject of evaporation should be treated under actual working conditions by using the entire Adirondack Park as a natural laboratory under the charge of a competent engineer to collect information bearing on the complex questions that will arise when the rivers in the Adirondack region are under regulation.

GROUND WATER STORAGE.

The site of the Big Tupper Lake reservoir, with the exception of the territory from Raquette falls to Palmer brook, and around the shores of the present Tupper lake, particularly in the vicinity of Wolf pond, Cross Clearing and Axton, is covered with a deposit of glacial drift of porous sandy material. It is a large glacial sand plain that is capable of holding within the interstices of the sand a very large amount of water.

This territory is so situated that this immense sand filter would yield a portion of its supply to the storage reservoir while being depleted in an amount that would largely compensate for the evaporation that would occur from the water surface of the reservoir. During the past season the run-off of the streams flowing from this sand plain has been enough greater per square mile in comparison with streams in the other districts to be apparent even to the inexperienced eye of a casual observer.

This fact has since been proven by an examination of the run-off data collected by the United States Geological Survey during the past two seasons.

I would respectfully suggest that, as soon as it is feasible, ground water studies be made of these sand plains to determine the elevation of the ground water, the loss of head, direction of underground flow and the probable underground storage available.

LITTLE TUPPER–ROUND LAKE PROJECT.

The principal work on the Little Tupper project includes a stadia survey of 57.2 miles of flow line topography; surveys of the dam site at the foot of Round lake and for the necessary dikes at Round lake, Lake Lila swamp, Stony pond and Mud pond at the foot of Slims; surveys for the relocation of a portion of the highway from Long Lake West to Long Lake within the reservoir limits and the topographical surveys for the hydraulic development of Little Tupper outlet.

Field work on the Little Tupper–Round lake project was started on July 16th by erecting triangulation stations and reading the necessary angles therefrom.

On July 22d, a stadia party was transferred from the work of locating the State land in the vicinity of Long lake and began taking flow line topography around Round lake. The men were quartered in tents, a camp being established near the foot of Little Tupper lake.

On August 2d, the work of the triangulation of Little Tupper and Round lakes having been tied into the main triangulation system from the Tupper lake project, the triangulation party was increased and proceeded to take flow line topography. On August 12th, a third party was organized for the purpose of making a thorough topographical survey for the purpose of determining alternative hydro-electric developments on the Little Tupper outlet, as well as to acquire full information with regard to the dam

RAQUETTE RIVER — SPERRYBROOK SWAMP.
In Little Tupper lake reservoir basin.

RAQUETTE RIVER — SLIM POND.
Dead timber along shores to be removed and swamps submerged.

site at the foot of Round lake. These surveys were extended and tied on the work of last season at the forks on Bog river about two miles south of Big Tupper lake.

On September 6th, some of the men left the work to return to college and the remaining force was combined into two parties, which completed the field work on September 14th, whereupon the camp equipment was removed to the Tupper Lake headquarters. A small party proceeded to make the survey of Stony, Slim, Little Slim and Mud ponds. A larger party was detailed to Long lake to complete the State land surveys previously referred to. A portion of the corps returned to the Tupper Lake headquarters and began the reduction of notes and the mapping of the surveys.

The stadia work taken on the Little Tupper project has been plotted on eleven sheets to the scale of 200 feet to 1 inch. The topography in the vicinity of the necessary dikes at Round lake, Lake Lila swamp, Stony pond and Mud pond have been plotted on four separate sheets to the scale of 40 feet to an inch. The topographical plan of the dam site at Little Tupper lake on a scale of 20 feet to an inch was submitted on October 21st, together with a complete topographical map on a scale of 100 feet to an inch of the district having a favorable location for the hydraulic development of the Little Tupper stream from the dam site at the foot of Round lake to the forks at Bog river.

The controlling factors on the Little Tupper project are the cost of acquiring and clearing the reservoir site, the treatment of the shores of the proposed reservoir and the relocation of the highway near the foot of Little Tupper lake.

In order to determine the most feasible point of crossing the Little Tupper lake about 200 soundings were taken at the foot of the lake from Johnson's camp to the ten-mile mark. The soundings were accurately located by the method of intersection of angles from triangulation stations on the opposite sides of the lake.

The country in the vicinity of the present road and in localities that were favorable for the relocation of the highway were surveyed in considerable detail. For the purpose of estimating the cost of the relocation of the highway that would be affected by the Little Tupper storage project, detailed studies were made for three possible routes across Little Tupper lake.

Route No. 1 follows approximately the present location of the highway, being carried across the swamps and across Little Tupper lake on a concrete steel trestle 20 feet wide and 2,240 feet long.

Route No. 2 follows the same general location as Route No. 1 and considers an earthen embankment instead of the concrete trestle. The existing highway bridges at the foot of Little Tupper lake would be used to span an opening of 200 feet in the embankment across the foot of the lake.

Route No. 3 is from the shore of the proposed reservoir near the twelve-mile mark on embankment to Johnson's Point, thence across the lake on a concrete trestle to the south shore and continuing along the north shore of Slim ponds to the five-mile mark. This latter route would eliminate the excessive grades of the present highway from the ten-mile mark to the foot of the Slims and would be the more feasible route so far as the question of grades is concerned. The excessive cost of the concrete trestle across the lake together with the necessity of building about six miles of new road makes this plan unattractive.

A careful comparison between Routes Nos. 1 and 2 showed that although there would be a considerable cost of maintenance on the earth embankment across the lake, it could be constructed more cheaply than the concrete trestle, and as an opening of 200 feet through the embankment will be sufficient for navigation and storage purposes, Route No. 2 was selected as being the more feasible and is included in the estimated cost of the project.

A ferry across the lake was considered in place of the above relocation of the highway and a capitalized sum determined which was much less than the estimated cost of constructing the embankment. This scheme was considered impracticable on the grounds that during the winter there is a heavy traffic on the highway from the railroad to the various lumber camps in the vicinity of Long lake, and it is doubtful if this traffic could be accommodated by a ferry during the winter season.

The dikes necessary on the Little Tupper project have been designed with very liberal slopes and for the flow line at elevations 1730, 1735 and 1740. The cost of the relocation of the highway was likewise considered for these three elevations of the flow line.

The result of a detailed study of this project shows that it is feasible to consider the flow line to elevation 1738 which would give an available storage of 4.68 billion cubic feet in the Little Tupper–Round lake reservoir. As the catchment areat of sixty-six square miles on the Little Tupper lake project would not furnish a supply sufficient to fill the Little Tupper reservoir every year, and from the fact that owing to scenic and æsthetic reasons it seems unwise to develop the Forked lake–Raquette lake project to the full capacity, the surplus from the watershed above the Forked lake dam could be held in the Little Tupper storage reservoir by conducting the extra supply through a tunnel connecting the reservoirs.

By combining the Forked lake and Little Tupper–Round lake projects, it would be possible to secure a storage of 7.14 billion cubic feet, at an estimated cost of $841,200. As this is at the very low rate of $118 per million cubic feet of available storage, and from the fact that it would supply about 67.5 per cent. of that of the Tupper lake project with the dam located at dam site No. 1 across Raquette pond near Tupper Lake village, with the advantage of the difference in first cost of $1,278,800, it presents an opportunity for the immediate development of the storage reservoirs in the Raquette watershed.

AVAILABLE DAM SITES BELOW TUPPER LAKE VILLAGE.

In passing below Tupper Lake village, the first dam site to be considered is that near the present Setting Pole dam.

The result of the topographical survey at this site showed the valley to be of such width that a dam of 1,200 feet long would be required to impound the water at the 1,570 flow line. In addition to the dam proper, it would be necessary to construct a dike 2,000 feet long impounding water to the depth of 20 feet across the swamp in the vicinity of the road to Piercefield. As there is no especially favorable solution of the railroad problem at this point, and as the capacity of the reservoir above this site would be about one billion cubic feet less than that above a dam constructed at Piercefield, the latter site was chosen for a more detailed study.

DAM SITE AT PIERCEFIELD.

A topographic survey was made of the locality immediately above the dam of the International Paper Company at Piercefield for a possible location for the main dam of the Tupper lake project.

It is not intended to submit an exhaustive report on a design for the dam and necessary dikes at Piercefield, the object of the survey being to secure sufficient information to determine whether it will be feasible to consider the location of the main dam of the Tupper lake project at Piercefield rather than at dam site No. 1 across Raquette pond.

The preliminary studies for the dam and relocation were gone into with considerable detail, an abstract of which, however, is only presented for consideration. The unit price for the several items is conservative and the sections liberal in order that a sufficient amount might be available for the minor details that have not been worked out.

The survey at Piercefield included four possible locations for the dam. After a preliminary study of all available sites, the section which offered the most feasible location was considered in more detail. The final location chosen for the purpose of the preliminary estimate requires a concrete Ogee dam forming a spillway 600 feet long, with an average height of 40 feet, founded on solid rock across the entire width of the river channel. An earthen dam or dike 1,200 feet long with a maximum height of about 40 feet was necessary to dam the valley on the north side of the river. A small dike 600 feet long with a maximum height of 35 feet was considered across the gulley south of the village.

In arriving at the property and land values within the reservoir that would be created with a dam at Piercefield, I have had access to the assessor's list from the town of Altamont for the year 1909, and the opinion of individuals conversant with property values in this vicinity.

The value of the property has been estimated with a liberal increased percentage over the assessed valuation of each parcel affected, the object being to arrive at a price that would be agreed upon between a willing seller and a willing buyer. The greater portion of the land required is owned by the International Paper Company and by Dr. Hass of New York city, who has a private reserve in the vicinity of Wolf pond. A reconnaissance of the territory in the vicinity of Wolf pond was made last year in connection with the investigation of possible reservoir sites and the information obtained has been incorporated in this study.

I made a personal inspection of the plants of the several lumber industries and of the right of way of the New York Central and the New York & Ottawa railways. The study of the relocation of the New York Central railroad was made from the United States Geological Survey topographical sheets and from the maps made by S. R. Farnsworth, C. E., in 1875, in connection with the survey of the land flowed by the dam at Setting Pole rapids, which in 1869 impounded water approximately to elevation 1555.

RELOCATION OF N. Y. C. R. R.

The project with the dam at Piercefield necessitates the flooding of about four miles of the N. Y. C. R. R. main line, besides its yards and property at the junction. For a relocation there are two possible solutions, one requiring 7.3 miles and the other about eleven miles of right of way, both routes having less rise and fall than on the present location.

The shorter route would be to leave the present road bed at a point about one and one-half miles north of Tupper Lake Junction, follow the new flow line to the outlet of Little Wolf pond, cross the stream on a bridge and follow the ridge to the present Setting Pole dam. Crossing the reservoir at the dam and the Piercefield flow on bridges, the main land and the present tracks would be reached about 0.3 miles beyond the present Piercefield station.

The second proposition is to leave the present location at a point four miles north of Tupper Lake Junction, cross the plateau east of Wolf pond, bridge the outlet of Big Wolf pond, proceed along the side hill to the divide in the ridge, thence along the south slope and through the divide 0.3 miles east of county line, along the north slope to the Piercefield dam, where the valley would be bridged in the vicinity of the dam, continuing along the side hill to the present location of the N. Y. C. & H. R. R. R. at the point 0.8 miles south of the present Childwold station. The first proposition, while greatly reducing the mileage, would have much greater bridge expense item and it would be impossible to say which would be the more economical proposition without a more extended field study.

The N. Y. & O. R. R. would be submerged; but, as the new location of the main line of the New York Central crosses this track there need be no further expense for the relocation of the N. Y. & O. R. R. beyond the connection of the tracks about two miles west of the proposed junction.

The railroad yards of the present junction could be moved to the plateau east of Big Wolf, which offers an excellent site for a new village or to Lake Clear Junction which would seem more feasible, as there would be considerable advantage on account of better facilities for transferring freight to the connecting railroads.

HIGHWAY RELOCATION.

About three and one-half miles of the highway from Tupper Lake to Piercefield would be flooded. At Piercefield about one-half mile of new road would be required to take the traffic over the river across the new dam. At Tupper Lake village it would require three and one-half miles of new road to the new junction and three miles from there to the present Piercefield highway. Assuming the new junction would require two miles of streets, we have a total of nine miles of new roads to be constructed.

To take the place of the present railroad from the junction to the village and the bus service, the cost of construction of a freight and express handling electric railroad from the new junction to Tupper Lake village was considered. This line could be very economically constructed in connection with the new highway.

DRAINAGE AREA AND CAPACITY.

A storage dam at Piercefield would increase the drainage area of the Tupper lake reservoir thirty-three square miles, making the total catchment area of the entire project 719 square miles, which is about 60 per cent. of the total drainage area of the Raquette river above Massena Springs, and about 73 per cent. of the drainage area above Colton.

The available capacity of the Tupper lake project considered last year would be increased 3.79 billions cubic feet between the elevations of 1550 and 1570, and 5.21 billions cubic feet between the elevations of 1550 and 1575. Combined with the available capacity of the Tupper lake project above Dam Site No. 1, a dam at Piercefield would create a storage reservoir of 14.76 billions cubic feet with a flow line at elevation 1570 and 19.56 billions cubic feet with a flow line at elevation 1575. The total amount of storage that would be ultimately required for the practical regulation of the Raquette river at Piercefield on the basis of 30 million cubic feet per square mile would be 21.69 billions of cubic feet. It would be possible to secure this storage with the dam located at Piercefield by raising the flow line slightly more than one foot, say to elevation 1576.5.

The following is a preliminary estimate of the cost of the Tupper lake project with a dam located at Piercefield instead of dam site No. 1, with the flow line considered at elevation 1570:

ESTIMATED COST OF TUPPER LAKE PROJECT.

Dam Located at Piercefield — Flow Line at Elevation 1570.

1. Earth excavation, 16,000 cubic yards, at $0.30	$4,800	
2. Rock excavation, 2,000 cubic yards, at $2	4,000	
3. Embankment, North dike, 240,000 cubic yards, at $0.50	120,000	
4. Embankment, South dike, 110,000 cubic yards, at $0.50	55,000	
5. Cyclopean masonry dam, 15,000 cubic yards; abutments, 3,000 cubic yards; piers for highway bridge, 200 cubic yards = 18,200 cubic yards, at $8	145,600	
	$329,400	
6. Engineering and contingencies, 20 per cent. (say)	65,600	
7. Railroad relocation:		$395,000
7.30 miles less bridges, at $40,000 per mile	$292,000	
Allowance for bridges	248,000	
Engineering and contingencies	60,000	
		600,000

8. Highway relocation:		
Nine miles at $6,000	$54,000	
Three and one-half miles, at $10,000.	35,000	
		$89,000
9. Land required, 4,100 acres, $20 (average)	$82,000	
Private property	261,000	
Industries and railroads	370,000	
		613,000
10. Capitalized sum, basis 3 per cent. interest on assessed valuation $220,000, for loss in taxes to villages		73,000
Cost Piercefield addition		$1,770,000
Cost of reservoir above dam site No. 1		920,000
Total cost of project		$2,690,000
On the above basis the estimated cost of the project with the flow line at elevation 1575 is		$3,267,000

Study of Promising Reservoir Sites.

The cost of the proposed system of storage reservoirs on the Raquette watershed is summarized on page 477 of the second progress report of the State Water Supply Commission for 1909. These estimates were largely the results of the reconnaissance of the reservoir sites made by Mr. Horace Ropes, Special Deputy Engineer, and myself during 1908.

During the past season additional data and information have been collected which enable us to estimate the cost of the proposed system in more detail and with greater accuracy. Changes occur, in some cases, from the adoption of new flow lines for the proposed reservoirs. In two projects, considered on the same basis as last season, a very close independent check on the preliminary estimate was obtained. This occurred in the Tupper

Raquette River.
Dam site on Bog river below Little Tupper lake, looking down stream.

Raquette River.
Dam site at Forked lake outlet.

RAQUETTE RIVER — LOWER RAQUETTE FALLS.
Below Long lake dam site.

RAQUETTE RIVER — COLD RIVER.
Below foot of Long lake.

lake project with the flow line at 1570 and in the Long lake project with the 1635 flow line.

According to the preliminary estimate of last season, the cost of the entire proposed system of reservoirs, having a combined effective capacity of 19,130 million cubic feet, was $3,397,500, or at the rate of $178 per million cubic feet of storage. By referring to project No. 2, Table III, it will be seen that the entire storage referred to above can be accomplished by means of a single reservoir with a dam at Piercefield, impounding water to elevation 1575, which would store 19,560 million cubic feet at an estimated cost of $3,267,000, at the rate of $168 per million cubic feet.

TABLE III.

SUMMARY OF COST OF STORAGE RESERVOIR PROJECTS.

	PROJECT.	Dam site.	Elev. of flow line.	Effective capacity in million cu. ft.	Total cost of project.	Cost per million cu. ft. of stored water.
1	Tupper lake.........	Piercefield....	1,570	14,760	$2,690,000	$183
2	Tupper lake.........	Piercefield....	1,575	19,560	3,267,000	168
3	Tupper lake.........	Dam site No. 1	1,570	10,970	2,220,000	202
4	Tupper lake.........	Dam site No. 1	1,575	14,350	2,550,000	178
5	Tupper lake.........	Oxbow.......	1,585	11,400	1,019,600	89
6	Little Tupper-Round lake..............	Round lake...	1,730	1,900	289,900	153
7	Little Tupper-Round lake..............	Round lake...	1,735	3,630	395,600	*109
8	Slims...............	Mud pond....	1,735	510	73,800	145
9	Little Tupper-Round lake and Slims.....	Round lake and Mud pond......	1,735	4,140	469,400	*113
10	Little Tupper-Round lake and tunnel from Forked......	Round lake...	1,738	4,680	675,500	145
11	Forked lake.........	Forked lake...	1,762	2,460	165,700	68
12	Long lake...........	Raquette falls.	1,635	1,200	131,000	109
13	Forked Lake and Little Tupper with tunnel............	(10+11).....	......	7,140	841,200	118

NOTE. Projects marked * have reservoirs larger than the contributing drainage area would fill every year and are submitted for comparison only.

A study of the more promising reservoir sites above Piercefield, summarized in the following Table IV, is submitted to show the possible combinations of reservoirs that are feasible and practicable, and also for comparison with the cost of a single large reservoir at Piercefield.

TABLE IV.

COMBINATION OF THE PROPOSED RESERVOIRS ON THE RAQUETTE RIVER WATERSHED.

Plan.	Combination of projects from Table III.	Available capacity in million. cu. ft.	Total cost.	Cost per million cu. ft.	Annual charges.
A	1 and 13	21,800	$3,531,200	$162	$170,000
B	4 and 13	21,490	3,391,200	158	173,500
C	4, 6, 11, 12	19,910	3,335,600	166	161,000
D	2	19,560	3,267,000	168	157,000
E	3 and 13	18,380	3,061,000	167	157,800
F	3, 6, 11 and 12	16,330	2,806,600	172	145,300
G	5, 6, 11 and 12	16,960	1,606,200	95	84,000
H	13	7,140	841,200	118	40,000

NOTE: The item of total cost includes the reservoir complete, together with the amount for acquiring lands and buildings; the clearing of the reservoir site and shore treatment; the building of culverts and bridges, etc.

The annual fixed charges include the annual interest at three per cent. on the total cost of construction; the annual payment to the sinking fund which will repay all cost to the State at the end of fifty years with an interest rate of three per cent.; taxes, or an equivalent payment to reimburse towns for taxable property flooded; repairs and depreciation on perishable portions of the dam and appurtenances, and operation and administration charges

The total amount of storage ultimately required for the practical regulation of the Raquette river at Piercefield on the basis of 30 million cubic feet per square mile for the 723 square miles of catchment area above Piercefield would be 21.69 billions cubic feet. However, for the reason that there is not an immediate need for the entire available storage except for flood control, it may be more economical and feasible to construct a system of the smaller reservoirs when warranted by the requirements of the power developments.

From the standpoint of the *maximum efficiency* in *conservation* of water, Plan B, Table IV, would be the most feasible. This plan is a combination of the Tupper lake reservoir with a flow line at elevation 1575 above dam site No. 1, and the Little Tupper–Forked lake reservoirs connected by a tunnel, and has the advantage of securing 7,140 million cubic feet of available storage at the construction cost of $841,200 for the immediate relief of the low water conditions on the Raquette.

The most *economical* system in point of the first cost of construction would be obtained by plan G which considers a dam at the Oxbow, impounding water to 1585, with additional reservoirs at Little Tupper, Forked and Long lakes. This plan would control 564 of the 723 square miles of watershed above Piercefield. The remaining 159 square miles of catchment area supplies Big Tupper lake; unless a system of controlling works or means for storage were installed below Raquette pond outlet, the run-off from this area would not be under regulation. Although this plan would introduce complex conditions for operating the controlling works of the entire system, it would not be detrimental to its adoption.

Plan E which combines the Tupper lake reservoir with a flow line at 1570 above Dam Site No. 1, together with the tunnel scheme of the combined Forked–Little Tupper projects, seems to be the more feasible from the standpoint of avoiding the destruction of the village of Tupper Lake Junction, and the present railroad and the manufacturing industries. It also would afford navigation from the head of Tupper lake to Raquette falls, and convert the swamp and waste land into a beautiful lake which would cause the minimum damage to the public at large.

A strong point in favor of plans F and G is that they afford improved navigation facilities which would result in better protection against fires in this section of the forest and thereby compensate in some measure for the timber lands acquired for the reservoir basins.

During the past two seasons, the writer has observed that the majority of the forest fires in the Raquette watershed originated along the banks of the river and as a rule resulted from the neglected camp-fires of touring parties. If these small fires could have been extinguished promptly many of the larger fires would have been eliminated.

One of the most important features in fighting forest fires is the element of time required to reach the site of the fires after they have been reported, and it is essential to have efficient means for transporting gangs to the scene of the fire without delay.

At present it is very difficult to reach the sites of these fires quickly either by teams or boats, owing to the lack of roads and to the shallow water in the river and lakes during the summer.

With the increased benefit to navigation afforded by the storage reservoirs, much time would be saved by transporting men and apparatus to the fire in launches of high speed.

With the improvement in navigation that these storage reservoirs would afford, it would be possible to maintain an improved fire service, so that more valuable timber would be saved from destruction by fires than would be taken in constructing the storage reservoirs in the Raquette watershed.

Respectfully submitted,

ERWIN E. HASLAM,

Resident Engineer.

V.

REPORT

OF

CHARLES T. RHODES, RESIDENT ENGINEER.

SURVEYS;
- Genesee River and Canaseraga Creek.

RECONNAISSANCES:
- Genesee River and tributaries.
- Chemung River.
- Alleghany River.
- Cattaraugus Creek.
- Buffalo creek.
- Minor western streams.

ALBANY, N. Y., *December* 31, 1909.

MR. WALTER MCCULLOH, *Consulting Engineer, State Water Supply Commission, Albany, N. Y.:*

DEAR SIR.— I beg to submit the following report of work done by your engineering force in the Western Division, during the year ending December 31, 1909.

The work accomplished consisted briefly of (1) completion of surveys and maps in connection with the projected improvement of the Genesee river, (2) surveys and maps necessary to define the area which would be benefited by the improvement of Canaseraga creek, as outlined by earlier surveys, (3) examination of the principal streams in the western portion of the State to determine what possibilities of water storage and power development exist upon them.

GENESEE RIVER SURVEYS.

At the beginning of the present year work was in progress upon a topographical survey of the Genesee valley from Mount Morris to Rochester, undertaken in order to determine just what land is subject to flood, and what work in the way of channel-straightening would be required to improve the present conditions. This survey was made by stadia methods, and as the configuration of the ground was not favorable for triangulation, a system of primary stadia traverses was used for control with very satisfactory results. Over sixty miles of bench levels were run, based upon several convenient bench marks of the U. S. Geological Survey and about 100 additional bench marks established, to which the stadia surveys were connected. An area of about 56 square miles was surveyed, and detailed topography taken, showing the contour of the ground, its subdivision and ownership, character of culture, and the location of all railroads, highways, buildings, fences, etc. A field force of twelve men was employed from the beginning of the year until the end of July.

Division headquarters were maintained first at Mount Morris and later at Rochester, with a computing and drafting force of two to four men. Here the field notes were reduced and the results mapped upon a scale of 100 feet per inch, these maps being later reduced to smaller scale and combined into final form at the Albany office.

Extensive inquiry was also made among landowners and residents for high-water marks of past floods, and many were obtained, representing in most cases the elevation reached by the flood of 1902, the greatest of recent years. In the northern portion of the valley, several records of the flood of 1865 were secured from old residents. Information was also obtained from surveys made in 1904 by the State Engineer's department, and many high-water marks on trees, and elsewhere, were observed directly by members of the force. All these data were carefully compiled, and profiles prepared showing the slope of the river under normal and flood conditions. The flood elevations thus obtained were plotted upon the contour maps, forming a preliminary outline of the proposed improvement district. Sketches of proposed cut-off channels and preliminary estimates of their cost were also made. Records were kept of the elevations of the river at various points, and the surveys connected to the gages maintained by the U. S. Geological Survey at the Mount Morris Power Company's dam and at Jones' bridge, and by the city of Rochester at Elmwood avenue bridge and at Court street dam, in order that the records of these authorities might be fully utilized.

FLOOD OF MAY, 1909.

While the above-described surveys were in progress, periods of mild weather produced several considerable fluctuations in the flow of the river, which are shown in sufficient detail by the regular gage readings. An especially pronounced thaw during the last week of February resulted in a flood which overflowed some 9,000 acres, located mainly between Mount Morris and Avon, and blocked for a day three of the highways which cross the valley, but was of such short duration and so early in the season as to do no considerable damage. Sketches of the flooded area were made, elevations reached by the water recorded, and an approximate determination of the rate of travel of the flood obtained.

At this time most of the snow which had accumulated ran off and the mild weather which prevailed during March and April made it seem probable that the spring flood would be of less extent than usual. On April 29th, however, a heavy snow storm occurred, turning to rain, and continuing with some intervals for three and one-half days, during which time the recorded precipitation at various stations of the U. S. Weather Bureau in and near the Upper Genesee valley ranged from three to four inches.

The effect of this storm was felt very quickly above Portage, but the flood here took the form of two distinct periods of high water, with a pronounced recession between them, and extensive damage was thus averted. In the lower valley, on the contrary, the rise resulting from the first day's storm was sufficient to overflow the river banks to some extent, and before there was time for the water thus spread upon the lower parts of the flat lands to run off, the second rise came, resulting in the most extensive flood, with one or possibly two exceptions, since 1865.

The Mount Morris-Geneseo road was covered for a few hours at low spots, but not seriously enough to interfere with traffic; the Town Line road, leading to Ballantine Bridge, five miles south of Rochester, was also practically uninterrupted. Between these points, a distance of twenty-eight miles, and also in the

Canaseraga valley for ten miles above Mount Morris, every road which crosses the valley was impassable for two to three days. About thirty dwellings and one schoolhouse, situated mostly in the broad part of the valley between Mount Morris and Geneseo, were surrounded by water, and access prevented except by boat. In no case, however, did water actually overrun the floors of the houses, as occurred in 1902. The tracks of the Dansville and Mount Morris Railroad were covered in several places in the Canaseraga swamp, but traffic was not interrupted.

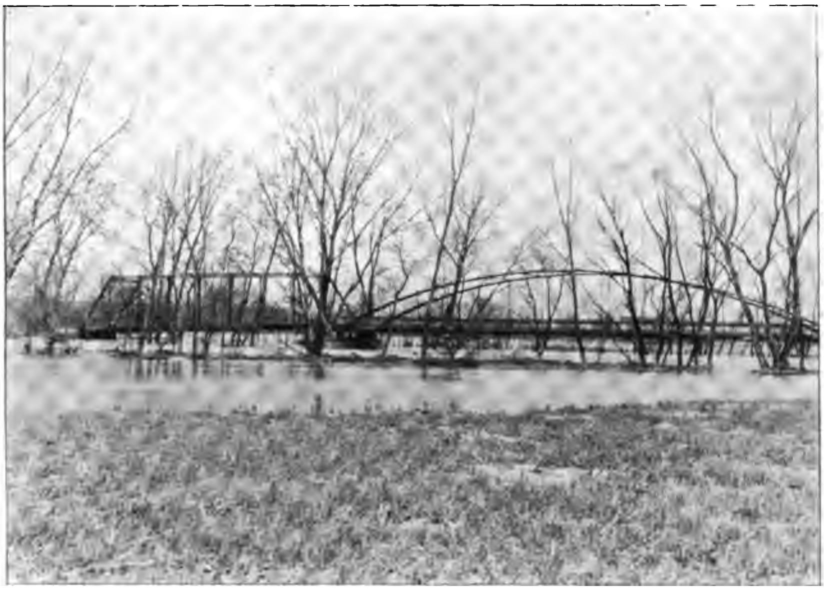
Fortunately for the residents of the valley, this flood occurred so early in the season that few crops were in the ground, and damage of this character was relatively small. Large tracts of low land were, however, so saturated as to delay materially their cultivation, and the expense of removing driftwood and other matter deposited by the water was in some cases considerable.

During the progress of this flood, and immediately afterward, our field force spent some time in determining the elevation reached by the water at many different points, and the extent of the overflowed territory, which is estimated as 15,000 acres in the Genesee valley between Mount Morris and Rochester, and 8,000 acres in the Canaseraga valley between Mount Morris and Dansville. The results of this work are embodied in a map and several tables which have already been submitted. Numerous photographs showing various phases of the flood were taken both by the Commission's photographer and by members of the engineering force.

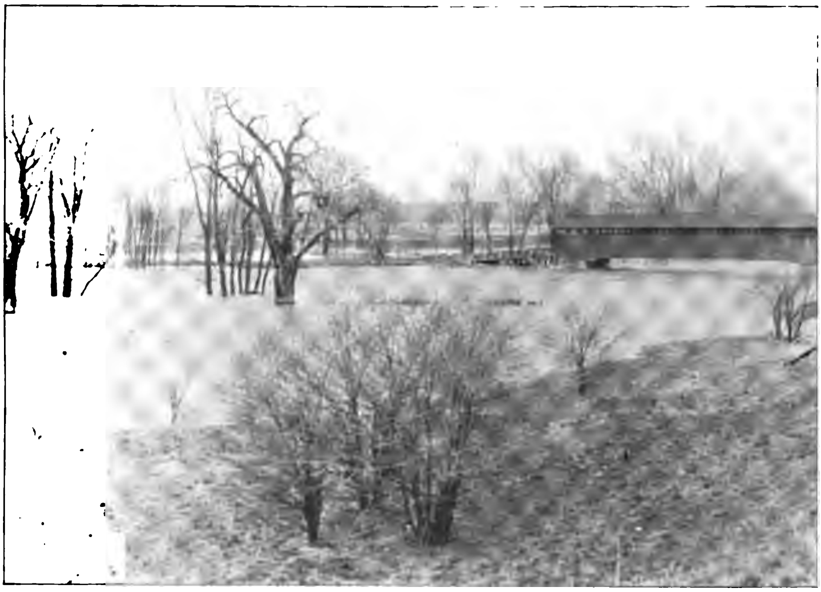
CANASERAGA CREEK SURVEYS.

Upon the completion of the Genesee river surveys described above, late in July, 1909, the entire force was transferred to the Canaseraga valley, and division headquarters re-established at Mount Morris. This project had already been investigated, and the work to be done determined, but under a recent change in the law it was required to define the extent and ascertain the ownership of the land which would be benefited by, and should bear the cost of, the projected work.

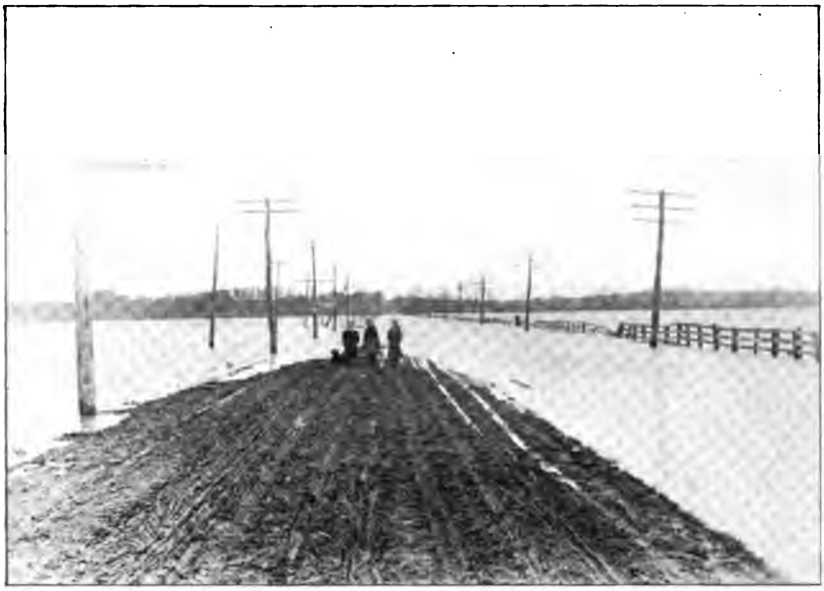
After a preliminary examination of the territory involved, it was decided that instead of making separate surveys of the outlines of the flooded area and the property lines within that area,



GENESEE RIVER — CUYLERVILLE BRIDGE.
Flood of May 3, 1909.



GENESEE RIVER — GENESEO BRIDGE.
Highway and farm lands flooded May 3, 1909.



Genesee River — Avon Highway, May 3, 1909.
This condition prevailed for about three days.

Genesee River — New York State Industrial School Farm Near Oatka, May 3, 1909.

it would be both quicker and cheaper to make a single stadia survey of the entire valley, from which all this information could then be obtained. A primary traverse and system of bench levels was therefore run, and stadia topography taken, exactly as already described in the case of the Genesee river surveys. The force employed was ten men in the field and two in the office, and the work, including computing and mapping on the scale of 100 feet per inch, occupied the months of August, September and October.

Much time and pains were spent in obtaining accurate knowledge of the extent of land which is subject to damage by flood. In the lower portion of the valley, near Mount Morris, this is a simple matter, for the slope of the valley is so slight that the more extensive floods transform it into a lake, having an approximately level water surface. Farther up, however, this is not the case. The slope of the valley and of the creek is greater; damage results not only from the submergence of tillable land by quiet water, but from the erosion of the soil by rushing water, and it may thus occur that relatively high land, unfavorably situated, sustains damage, while lower fields, more fortunately located, escape it.

Almost every owner and resident of the valley was interviewed, and from many of them valuable information was obtained, in the form of high-water marks, and their recollection of the extent of past floods, particularly that of 1902, which here, as in the Genesee valley, was the most extensive and destructive of recent years. Additional data were secured from the engineering department of the D. L. & W. R. R., from the superintendent of the D. & Mt. M. R. R. and from personal observation. All this matter was embodied in detailed statements for record, and in a flood profile.

After the completion of this field work and large scale mapping, the maps so plotted were reduced to a scale of 400 feet per inch, and embodied in a single sheet, on which was plotted also the outline of maximum flood, as determined from the various data enumerated above. This line constitutes the boundary of the improvement district, and a written description of it, by courses and distances, was prepared.

An investigation of the records of the county clerk's and surrogate's offices at Geneseo was also made by the resident engineer in connection with the Commission's attorney, to establish with some certainty the ownership of the various parcels of land included within the improvement district. As there are a number of instances of undivided estates, entailed lands, purchases by contract without actual transfer of title, and other complications, this proved to be a rather extensive task and consumed several weeks. It was found that the information previously obtained in the field was substantially correct in most instances, but many changes and additions were made as a result of this search. A map was then prepared showing the location, area and ownership of each parcel of land within the district, and a description of each separate parcel written and prepared for filing.

The following table shows the essentials of the Canaseraga creek improvement district:

Area covered by surveys....................	13,900	acres.
Area determined to be benefited by regulation of floods..............................	10,989	acres.
Length of boundary of improvement district....	32.7	miles.
Number of separate parcels in improvement district..............................	165	
Total number of persons and corporations interested as owners of these lands...........	267	

A reconnaissance was made in the upper Canaseraga valley, above Dansville, to determine the feasibility of storing flood waters at this point, and thus lessening the volume to be handled by the channel in the lower reaches of the stream.

An excellent dam site exists at the lower end of " Poag's Hole," about two miles from Dansville, and just above the mouth of Stony brook. Here the creek flows for several hundred feet through a shale gorge about 175 feet wide and more than 100 feet deep, with nearly vertical sides. Above this point for some six miles is a narrow, steep-sided valley, which except at the extreme lower end contains only a rather poor quality of farm land, including considerable areas which are given over to brush and weeds.

The slope of the valley floor is so considerable that the available storage is small in comparison with the cost of the reservoir. There is little natural fall at the dam site, and no considerable power could be developed except for a short period during the season of greatest stream flow.

Storage to elevation 780 would produce a reservoir slightly less than two miles long, its upper end being just below the existing highway bridge over the creek. With storage to elevation 800, the length of the reservoir would be about two and one-quarter miles.

These surveys have been plotted on a scale of 200 feet per inch, and the following approximate estimates made for two different heights of dam, located at the point described above:

	Elevation of Water surface.	
	780	800
Drainage area, square miles	90	90
Area of water surface, acres	223	293
Capacity of reservoir, million cubic feet	279	503
Storage per square mile, million cubic feet	3.10	5.60
Maximum height of dam, feet	75	95
Mean length of dam, feet	158	174
Estimated cost of dam and controlling works	$110,000	$215,000
Estimated cost of land damages	12,000	14,000
Estimated cost of highway relocation, etc.	6,000	8,000
Total	$128,000	$237,000
Cost per million cubic feet stored	$459	$471

This reservoir as already stated would control the flow from an area of ninety square miles, or about half of the total watershed of the creek at Cumminsville bridge, which is the upper end of the territory most subject to flood damage. Additional storage at somewhat higher cost could be secured on Stony brook, which has a drainage area of twenty-seven square miles. Both these projects are deemed too expensive for further consideration.

COST OF STADIA SURVEYS.

The appended table shows unit costs of the topographical surveys made in 1908 for the Portage reservoir project, and in 1909 for the projects described above. For comparison with other figures of the same nature, it may be stated that these costs include all expense of every nature such as rent, light and heat of field offices, livery, traveling expenses, stakes and office supplies, which was incidental to the field work, and to the reduction of the notes, plotting them to a large scale on detail paper, and inking the resulting maps.

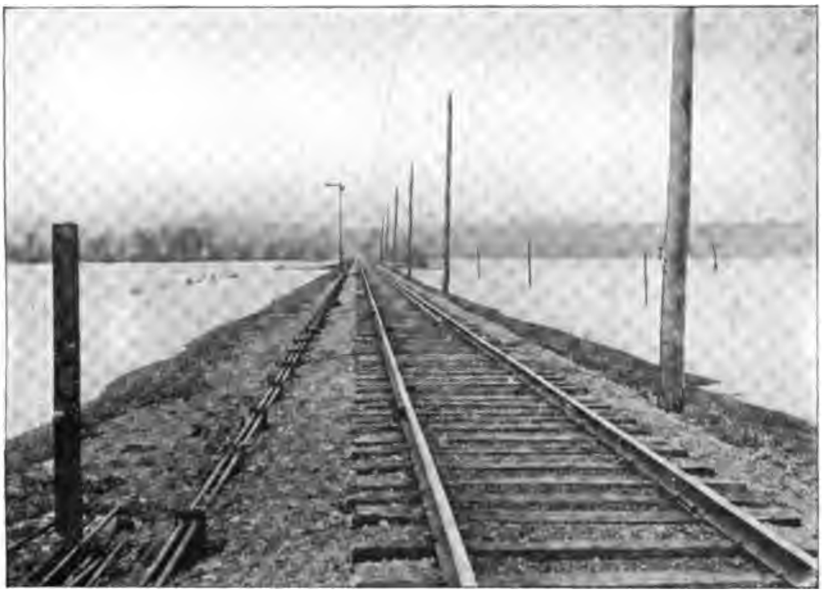
The reduction of these original maps to smaller scales and their preparation in final form for filing or publication was not done by the division force, but at the Albany office, and the cost of this work is not included here.

The large reduction in cost between the Portage and Genesee surveys is due to the more favorable ground encountered, to the greater proficiency of the men employed, most of whom were at first entirely unfamiliar with stadia surveys, and to the interest taken by them in the work, and the resulting improvements in methods which were brought into use from time to time. The Canaseraga costs are somewhat lower than those of the Genesee, mainly because of the more favorable season at which the work was done.

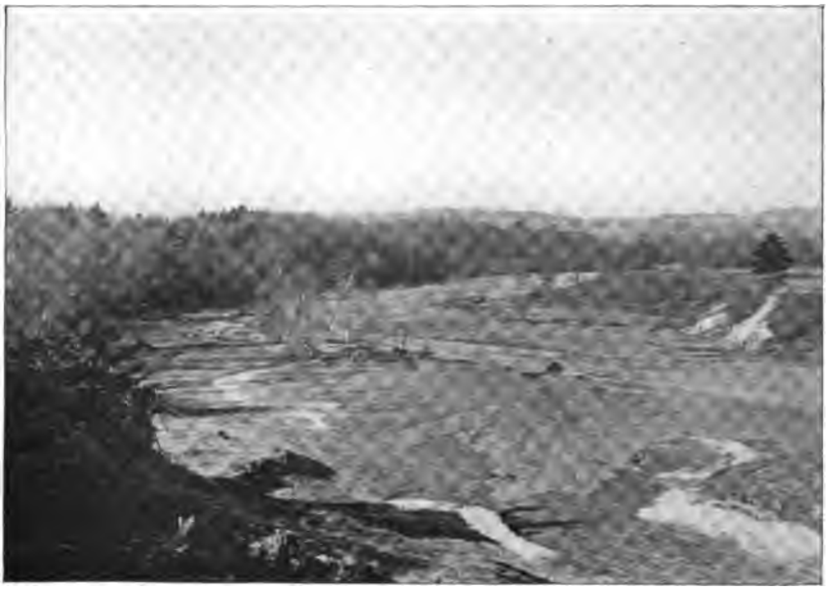
	Portage Reservoir, June–Nov., 1908 18.2 sq. mi.		Genesee River Improvement, Nov. '08, July, 1909, 56.1 sq. mi.		Canaseraga Creek Improvement Aug.–Oct., 1909. 21.8 sq. mi.	
	Total	Per Sq. Mi.	Total	Per Sq. Mi.	Total	Per Sq. Mi.
Field salaries	$6,845	$376 10	$8,681	$154 70	$2,928	$134 40
Field expenses and supplies	1,188	65 30	1,284	22 90	485	22 20
Total field work	8,033	441 40	9,965	177 60	3,413	156 60
Office salaries	2,320	127 40	2,901	51 70	1,175	53 90
Office expenses and supplies	159	8 80	342	6 10	105	4 80
Total computing and mapping	2,479	136 20	3,243	57 80	1,280	58 70
Total cost	$10,512	$577 60	$13,208	$235 40	$4,693	$215 30

STREAM RECONNAISSANCE.

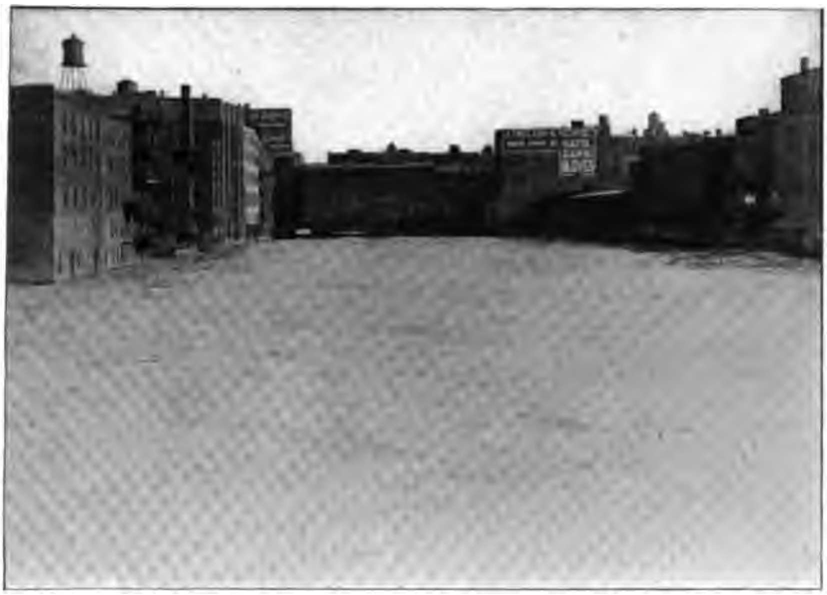
Your instructions directed me to examine the principal streams of the State, west of Elmira and Oswego, except the Niagara river and those streams which are, or are to be, utilized in connection



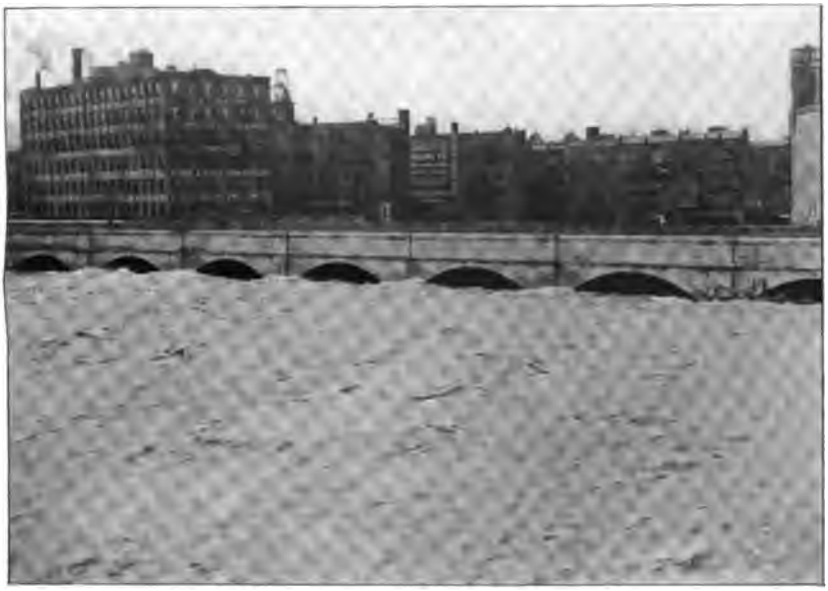
Genesee River — May 3, 1909.
Erie railroad, looking northerly from the Delaware, Lackawanna & Western railroad crossing.



Genesee River.
An example of damage done to farm land by floods.



Genesee River — Rochester, May 4, 1909.
Flood at the Main street bridge reaching the danger point.



Genesee River — Rochester, May 4, 1909.
Erie canal aqueduct.

with the water supply of the Erie canal, in order to ascertain what possibilities of water storage and power development exist upon them. Few such opportunities were found and much of the information obtained was negative in character.

The streams included in this territory are as follows:

Genesee river and tributaries,

Chemung river, including Canisteo and Cohocton rivers,

Allegany river and tributaries,

Cattaraugus creek,

Buffalo creek and tributaries,

A number of minor streams tributary to Lakes Erie and Ontario.

These streams were traversed, in some instances merely by traveling along their valleys by train, where such an examination was sufficient to show the nonexistence of suitable storage or power sites; in other cases by driving and walking to the points of greatest importance. Where it seemed worth while to make detailed examination, measurements were taken by pacing and elevations determined by hand level, so that the results can be considered only as roughly approximate, but are thought to be sufficiently accurate for the present purpose.

GENESEE SYSTEM.

The most considerable opportunity for storage and power development in the western portion of the State is located at Portage, on the Genesee, but has been extensively studied and need not be further considered here.

The upper portion of the Genesee river, together with several of its tributaries, were examined in 1907 by Mr. George G. Shedd, whose report is found in the report of this Commission for February 1, 1908. The information there contained was deemed sufficient to show that no practicable opportunities existed on the streams covered by it with two exceptions, which were re-examined.

On the main river about four miles above Wellsville, there is an excellent opportunity for a dam and reservoir, which as stated by Mr. Shedd would have a water surface about two miles long and three-quarters of a mile wide, and a capacity of 850 million cubic feet. The reservoir site is, however, traversed by the main line of the Buffalo & Susquehanna Railway, and the cost of relocating this road would unquestionably be so great that the location cannot be considered feasible for development.

On Caneadea creek, about two miles west of the Genesee river, and one-half mile above the bridge of the Buffalo and Susquehanna Railroad, there is a fine dam site at the head of a considerable gorge. This project was also included in Mr. Shedd's report, and as stated by him a dam eighty-four feet high would create a reservoir having an area of nine-tenths of a square mile and a capacity of 1,000 million cubic feet. With this storage capacity an average of 850 horsepower could be developed. This is decidedly the most favorable opportunity upon the Genesee system.

Another small opportunity is found upon Silver lake outlet, at Perry. The drainage area of this stream at the foot of the lake is about twenty-four square miles, but the lake being fed to some extent by springs in its bottom, the run-off is relatively high, being estimated at 100 cubic feet per second for about eight months of the year, with a minimum of forty cubic feet per second. There is virtually no opportunity for storage, as there is a railroad along the shore of the lake, as well as a number of cottages, icehouses, etc., but the water now available might be better utilized by concentrating its development in a single point at Perry and another near Gibsonville, instead of the present arrangement of several plants, separately owned, each developing only a fraction of the available head.

CHEMUNG SYSTEM.

The Chemung river is formed at Painted Post by the junction of the Cohocton and Canisteo rivers and is itself tributary to the Susquehanna river near Athens, Pa., just south of the State line. It drains most of Steuben and Chemung counties and small portions of adjacent counties.

Drainage areas are as follows:

Cohocton river at mouth................	600 square miles
Canisteo river at mouth.................	645 square miles
Chemung river at State line.............	1850 square miles

The main Chemung river, from Painted Post to the State line near Waverly, has a fall of about 120 feet in thirty miles. The valley is broad and flat, largely under cultivation, and not well suited for reservoir construction. There is one point, locally known as "the Narrows," about six miles above Elmira, where a few feet of fall might be utilized, but no opportunity to secure any but the natural flow of the stream.

The Cohocton river rises in the extreme southeastern portion of Livingston county, and flows southeasterly for about fifty miles to Painted Post. Its watershed is relatively narrow, quite hilly in character, and contains little forest but large tracts covered with brush which has grown up after lumbering operations. The stream has a fall of about 400 feet between Atlanta and Painted Post, a distance of forty miles, distributed with some uniformity throughout its entire length, and including no falls of any consequence. It is traversed for almost its entire length by the main line of the D. L. & W. R. R. and the Rochester division of the Erie R. R. which cross and recross the river several times. This precludes the raising of the river level at any point more than a few feet without relocating these railroads, and the cost of such relocation would be entirely too great for consideration.

The Canisteo river rises in eastern Allegany county, and flows southeasterly for about fifty miles to Painted Post, receiving as tributaries several creeks of minor importance. Between Hornell and Painted Post, a distance of thirty-seven miles, it has a fall of about 240 feet, including sundry rapids, but nothing which can be classed as a waterfall. There are no favorable dam sites, and the presence of the main line of the Erie Railroad serves to eliminate this stream as a possible site for storage.

On Canacadea creek above Hornell the Erie Railroad is located upon the side hills instead of in the valley. This stream is too small to be considered as a storage and power project, but two or three possible dam sites were noticed, both above and below the village of Almond, where it would seem possible to store flood waters temporarily, and thus relieve to some degree the flood conditions which have several times in recent years been so disastrous at and near Hornell. As this matter is outside the scope of the present inquiry, no detailed study was made.

ALLEGANY SYSTEM.

The Allegany river enters the State at a point about ten miles southeast of Olean, flows irregularly westward through southern Cattaraugus county for about forty-seven miles, and returns to Pennsylvania at Corydon, receiving Olean creek and other minor tributaries. Its drainage area in this State is 1,010 square miles. Its valley, though bounded by high steep hills, is broad and very flat, and the river's course through it is tortuous, resulting in extensive spring floods. There is no practicable site for a dam or reservoir.

Conewango creek rises in the northwestern portion of Cattaraugus county, and flows southerly for about thirty miles, leaving the State at Fentonville, and reaching the Allegany at Warren, Pa. It drains the western portion of Cattaraugus county and most of Chautauqua county, an area of about 770 square miles. Its course is through a broad, flat valley, offering no opportunities for development.

Tributary to this stream through Chadakoin river is Chautauqua lake, with a drainage area of 210 square miles. In the five miles below the mouth of the lake, and located entirely within the city of Jamestown, this stream has a fall of about fifty feet, which is now used by a series of small plants. Some storage could be obtained by a dam at the foot of the lake, but its water surface cannot be raised more than a few feet without interference with a number of dwellings and other buildings. A concentration of the available fall at a single point would tend to much greater efficiency, but would require the co-operation of the present owners.

Several schemes have been advanced, looking toward the diversion of a portion of the water of Chautauqua lake into Lake Erie, which would give a head of about 500 feet, but the obstacles in the way of such diversion are so considerable that nothing tangible has been accomplished.

CATTARAUGUS CREEK.

This stream rises in the southwestern part of Wyoming county, and drains portions of Wyoming, Cattaraugus and Erie counties. Its watershed is of a decidedly hilly character, embracing some of the highest ground, and the major part of the forest which exists in the western end of the State. It is also noteworthy as being the one considerable stream in this region which is not now, nor likely to be, paralleled by a railroad. Drainage areas are as follows:

Main stream at junction of South Branch	333 square miles
South Branch	101 square miles
At Versailles	472 square miles
At mouth	560 square miles

No records of the actual discharge of the stream are available. The rainfall records of the U. S. Weather Bureau show a mean annual precipitation over all but the extreme lower portion of the watershed, of approximately forty-one inches. It seems safe, therefore, to use as estimated annual run-off the relatively low figure of eighteen inches.

The plan suggested for the development of this stream comprises: A small storage reservoir at the hamlet of Zoar, eight miles above Gowanda and seven miles below Springville, which will impound 850 million cubic feet of water and serve to more than double the natural flow during the working hours of the summer months; a dam at Versailles, six miles below Gowanda, with just enough storage capacity above it to retain the night flow of the stream for daytime use, should this be desired; and a power plant a short distance below this dam, developing a total head of fifty-five feet, and producing 2,300 available horsepower for twelve hours per day during the three summer months, and for twenty-four hours per day at other times.

No suitable reservoir site was found on the South Branch, but as this portion of the watershed is extensively timbered and very thinly settled, the run-off from it is more regular than from the main stream.

On Cattaraugus creek proper no reservoir site of capacity sufficient to completely regulate the flow of the stream was found, but an especially favorable opportunity for a small amount of storage exists at the hamlet of Zoar, already mentioned. At this point a masonry dam could be located at the upper end of a gorge several miles in length, thus overflowing a tract about two miles long and one-third mile wide, none of which can be classed as more than moderately good farming land, and also backing the water into the narrow valley of the stream for an additional distance of two and one-half miles.

The approximate dimensions and estimated cost of this suggested reservoir may be stated as follows:

Drainage area, square miles	315
Area of water surface, acres	900
Capacity of reservoir, million cubic feet	850
Storage per square mile, million cubic feet	2.70
Maximum height of dam, feet	45
Mean length of dam, feet	350

Estimated cost of dam and controlling works	$87,000
Estimated cost of land required	20,000
Estimated cost of highway relocation, etc	15,000
Total	$122,000
Cost per million cubic feet stored	$143

The amount of storage provided by this estimate can be considerably increased by the erection of a higher dam and the submergence of a greater area; but it is found that the cost of such addition increases more rapidly than the quantity of water thereby stored. Additional storage can also be secured near Springville, by the construction of a dam just above the bridge of the B. R. & P. R. R., but in view of the smaller drainage area at this point, the steeper slope of the valley, and the higher value of the land which would be submerged, this site is not considered an economical one.

As has already been stated, the storage of this quantity of water will not suffice to regulate the flow of the stream to a uniform quantity through the entire year. It will, however, if released during the driest months, serve to increase the natural flow of these periods and make it nearly as great as the natural flow during the fall and winter. On a basis of twelve hours per day for 100 days, the increase thus obtained will be 200 c. f. s. By constructing a small reservoir in connection with the power plant, and storing the waters of the night for use during the day, a uniform flow of 500 c. f. s. would be obtained for twelve hours per day during the three driest months, and for twenty-four hours per day at other seasons. The power plant estimates which follow have been made on this basis.

The best location for power development on this stream is at Versailles, six miles below Gowanda. No single waterfall exists here, but a series of small rapids, which at the steepest part have a fall of some twenty feet in one-third of a mile, and above that point an average fall of fifteen to twenty feet per mile for a long distance. The site selected is at the head of this steep portion, near the remains of a timber dam which was wrecked by flood a few years ago. The bottom of the channel is of good shale, which is found also in the banks under a light cover of earth. The maximum height of dam which can be built without flooding the village is about forty feet, which would produce pondage of the stream for about two and one-quarter miles, thus creating the suggested small secondary reservoir.

Details of the construction proposed here are as follows:

Length of dam, feet	275
Height of dam, feet	40
Area overflowed, acres	250
Head developed, feet	55
Available horsepower (at 75 per cent. efficiency) with flow of 500 c. f. s	2,300

Estimated cost of dam and accessories	$85,000
Estimated cost of land overflowed	3,000
Estimated cost of hydro-electric plant	110,000
Total cost	$198,000
Total cost of reservoir and power plant	320,000
Cost per horsepower	140

The apparent market for power developed at this point comprises, in addition to the village of Gowanda, which is within six miles of the proposed plant, the cities of Dunkirk, Jamestown and Salamanca, all of which are within a radius of thirty miles.

In addition to the new development at Versailles described above, this partial regulation of stream flow would add to the existing water power at Gowanda, an estimated amount of 330 horsepower during the summer months.

MINOR STREAMS TRIBUTARY TO LAKES ERIE AND ONTARIO.

The most considerable stream in this class is Buffalo creek, including Cayuga and Cazenovia creeks, and having a total drainage area of 410 square miles. All these creeks are sluggish in flow, and lack well-defined valleys. No reservoir or power sites were found.

Eighteen-mile creek, in Erie county, has one or two undeveloped water powers in addition to those now in use but they are too small to warrant further study.

Turning to the streams which enter Lake Ontario, power plants of some importance are found on Eighteen-mile creek at Lockport, and on Oak Orchard creek below Medina, as well as a number of smaller plants. Most of these are already using substantially all the power available, and as much of this water is only the surplus from the Erie canal, and thus of somewhat uncertain permanence, no additional development seems practicable.

Irondequoit creek is too small in its upper portion and too flat in its lower portion to afford any opportunities, and there is no stream of any consequence east of it.

SUMMARY.

The results of the reconnaissance detailed above may be summarized briefly as follows:

An opportunity for the partial regulation of the flow of Cattaraugus creek by the storage of 850 million cubic feet and the development of 2,300 horsepower at a cost of about $320,000.

An opportunity for a smaller development on Caneadea creek.

Opportunities for the improvement of existing powers on Silver lake outlet, at Perry, and on Chadakoin river, at Jamestown.

Respectfully submitted,

CHARLES T. RHODES,
Resident Engineer.

APPENDICES.

A. REPORT ON HYDROGRAPHIC WORK CARRIED ON IN CO-OPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY.

B. DECISIONS OF THE COMMISSION ON WATER SUPPLY APPLICATIONS.

C. LAWS RELATING TO THE COMMISSION.

D. RULES GOVERNING WATER SUPPLY APPLICATIONS.

E. FINANCIAL STATEMENTS.

APPENDIX A.

REPORT ON HYDROGRAPHIC WORK CARRIED ON IN CO-OPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY.

By C. C. Covert, District Engineer, U. S. Geological Survey.

APPENDIX A.

REPORT ON HYDROGRAPHIC WORK CARRIED ON IN CO-OPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY.

LETTER OF TRANSMITTAL.

Department of the Interior,
United States Geological Survey,
Water Resources Branch,
18 Federal Building,
Albany, N. Y., *February* 1, 1910.

Mr. Walter McCulloh, *Consulting Engineer, State Water Supply Commission of New York, Albany, N. Y.:*

Dear Sir.— I hand you herewith my report on the hydrographic work carried od in co-operation with your Commission during 1909. The report also includes revisen monthly estimates of work for 1907–'08.

Previous to March 1, 1909, this work was under the direction of Mr. H. K. Barrows, District Engineer, U. S. Geological Survey, Boston, Mass. Subsequent to that date it has been under my direction, and I have been assisted by Mr. W. G. Hoyt, Junior Engineer, and Mr. W. A. James, Computor.

The revised monthly estimates for 1907–'08 have been made under the direction of Mr. R. H. Bolster, Assistant Engineer in charge of the computing section in the Washington office. They are based on additional data obtained during 1909 and supersede all previous published estimates for these stations. Mr. Bolster also rendered considerable assistance in making the 1909 computations.

Acknowledgment is also made of assistance rendered by the several Resident Engineers of the Water Supply Commission in checking gages and obtaining gage heights, and by E. F. Weeks in making high-water gagings.

Very truly yours,

C. C. Covert,
District Engineer.

REPORT UPON HYDROGRAPHIC CO-OPERATIVE WORK.

During August and September, 1907, the following gaging stations were established for the State Water Supply Commission:

Hudson river at North Creek.
Hudson river at Thurman.
Schroon river at Riverbank.
Sacandaga river at Wells.
Sacandaga river at Northville.
Sacandaga river at Hadley.

During 1908 the following stations were established:

Schroon lake at Pottersville — July 8, 1908.
Genesee river at St. Helena — August 14, 1908.
Genesee river at Jones' Bridge, near Mt. Morris — August 12, 1908.

Raquette river at Raquette Falls — August 27, 1908.

Raquette river at Piercefield — August 20, 1908.

Bog river at Tupper Lake — August 24, 1908.

These stations were all established under direction of Mr. H. K. Barrows, and the records have been continued during 1909. September 24, 1909, one additional station was established at the lower highway bridge at Hadley, N. Y., on the Sacandaga.

The standard methods of the United States Geological Survey have been used in making gagings at these stations. The results are given below, as far as available at this time.

(1) Station description.

(2) List of current meter discharge measurements.

(3) Daily gage heights.

(4) Estimated daily discharge.

(5) Estimated monthly mean, maximum and minimum discharges.

There are also included the results of gagings made during 1909 at the following gaging stations of the United States Geological Survey:

Raquette river at Massena Springs.

Genesee river at Mt. Morris.

Hudson river at Mechanicville.

ACCURACY AND RELIABILITY OF FIELD DATA.

Practically all discharge measurements made under fair conditions are within 5 per cent of the true discharge at the time of observation. Generally speaking, the errors in meter measurements are largely compensating; therefore the mean rating curve, when well defined, is considered much more accurate than the individual measurements.

The work is, of course, largely dependent upon the reliability of the observers. With but few exceptions the observers perform their work honestly. The observations are made twice each day — morning and evening. While these do not always give the mean height for that day, these erorrs also are compensating and can be considered as negligible for a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added and an accuracy column is inserted in the monthly-discharge table. The accuracy column does not apply to the maximum or minimum, nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent.; B, within 10 per cent.; C, within 15 per cent.; D, within 25 per cent. Special conditions are covered by footnotes.

HUDSON RIVER DRAINAGE BASIN.

Description.

The principal sources of Hudson river lie in the wildest portion of the Adirondack mountains, in Essex county, northeastern New York. A number of branches, any one of which might possibly be considered the main stream, form its upper waters; but if the highest collected and permanent body of water be assumed as the true head, then the source of the Hudson becomes Lake Tear-of-the-Clouds, which lies at an elevation of 4,322 feet above tide, in the center of the triangle formed by Mount Marcy and Skylight and Gray Peaks.

The river flows rather irregularly southward until it reaches the northern boundary of Saratoga county, where it makes a sharp turn and flows eastward for about 12 miles, passing through the mountains and forming, as it cuts across the rocky strata, several falls of great height and beauty. At Sandy Hill, just below Glens Falls, it makes another abrupt turn and flows southward, continuing in this direction until it empties into New York bay.

From Lake Tear-of-the-Clouds to the mouth of the river the distance by water is probably about 300 miles. The total area drained is 13,366 square miles. The river is tidal to Troy, which is also at the head of navigation.

The headwater region is mountainous in character, is in general heavily wooded, and is dotted with numerous lakes and ponds. The rocks, belonging to the oldest formation and mainly granitic, are either bare or covered only with a layer of spruce duff, humus, and forest litter. The river emerges from the mountain region a few miles west of Glens Falls, and thence to Troy the topography is moderately rolling and the surface soil is chiefly sand. Below Troy the river follows the great depression which extends almost due north and south between New York bay and the St. Lawrence, flowing in an open valley bordered by well-cultivated lands, which rise with moderate slope from the stream. The Catskill Mountain region is reached 20 or 30 miles below Albany, and thence to the mouth of the river the immediate valley is flanked by high hills, the Highlands of Orange county and the precipitous Palisades being especially noticeable.

The fall in the upper portion of the course is very rapid, amounting to about 64 feet per mile from Lake Tear-of-the-Clouds to the mouth of North creek, a distance of about 52 miles. From the mouth of North creek to the mouth of the Sacandaga the descent is nearly 14 feet per mile, distributed among rapids which diminish in frequency as the Sacandaga is approached. In the succeeding 26 miles to Fort Edward the river descends 418 feet more, but of this 175 feet is comprised within the three abrupt pitches at Palmer, Glens, and Bakers Falls, while most of the remainder occurs in the rapids between Jessups Landing and the oxbow above Glens Falls. Between Glens Falls and Troy nearly the entire fall of the river is utilized for the development of water power.

The tributaries of the Hudson are numerous, and many of them are large and important. Indian river, Schroon river, and the Sacandaga unite with the main stream above Glens Falls, and between the latter point and Troy it receives Batten Kill, Fish creek, Hoosic river, and the Mohawk, the latter having several important tributaries, including West and East Canada and Schoharie creeks. The tributaries below Troy include Catskill, Esopus, and Rondout creeks, and Wallkill river from the west, and Kinderhook creek, Jasen Kill, Wappinger creek, Fishkill creek, and Groton river from the east.

The mean annual precipitation on the total basin of the Hudson is probably about 43 inches. It reaches a maximum of more than 55 inches in the heights of the Adirondacks, while in the eastern portion of the drainage area in southern Vermont the mean annual total is only about 39 inches. Conditions during the winter period vary from the extreme cold and deep snow of the Adirondacks to the areas in the southern portion of the basin which are subject to frequent winter thaws.

The flow of the Upper Hudson is controlled to some extent during the dry season by the use of Indian Lake storage reservoir, and the natural storage facilities in the

Adirondack region are unsurpassed, there being a great many ponds and lakes, many of large size and fed from extensive drainage areas. Comprehensive plans for vast storage projects on the Sacandaga, Schroon, and Upper Hudson are receiving the attention of the New York State Water Supply Commission. It is probable that on the various tributaries of the Hudson an increase in storage capacity of some 75 billion cubic feet is possible, and if this were developed the Hudson would be probably the most important water-power stream in the country. While a large amount of power has been developed in the Hudson drainage area, there are vast quantities as yet unutilized, and the impotrance of this river basin is apparent when it is considered that in proportion to its size it contains a greater population than any other important drainage basin in the United States with the single exception of that of the Delaware river.

The longest run-off record in the Hudson River drainage basin is that obtained at Mechanicville, which extends back to 1888.

Hudson River at North Creek, N. Y.

This station is located on the steel highway bridge at North Creek. It was established, in co-operation with the U. S. Geological Survey, September 21, 1907, to obtain general statistical and comparative data in regard to the flow of the Hudson river.

North creek, a small tributary of the Hudson, enters from the right a short distance below this point.

The gage datum has remained the same during the maintenance of the station. During the winter months the discharge is affected by the presence of ice. Conditions for obtaining the accurate discharge are good and a very good rating curve has been developed.

The regimen of flow of the upper Hudson, especially during the low-water season, has been considerably affected by storage in Indian Lake reservoir.

Information in regard to this station is contained in the annual reports of the U. S. Geological Survey.

Discharge measurements of Hudson River at North Creek, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.ft.*	*Feet.*	*Sec.-ft.*
Jan. 1	C. R. Adams	215	427	2.88	(*a*)419
Jan. 20	C. R. Adams	225	463	3.46	(*b*)452
Mar. 27	C. C. Covert	248	598	4.12	(*c*)990
April 14	C. C. Covert	250	1,990	8.35	14,200
April 16	E. F. Weeks	250	1,740	7.74	11,400
April 18	E. F. Weeks	250	1,660	7.40	10,200
May 9	E. F. Weeks	250	1,390	6.32	7,040
May 21	C. C. Covert	250	1,010	4.78	3,510
June 17	Covert and Cooper	230	549	3.00	865
Aug. 24	W. G. Hoyt	245	524	2.73	653
Aug. 25	W. G. Hoyt	245	566	2.95	796
Dec. 9	Hoyt and James	243	386	2.32	(*d*)277
Dec. 11	Hoyt and James	237	448	2.48	(*d*)373

(*a*) Measurement made under partial ice cover. Gage height to top of ice, 2.98 feet; average thickness of ice, .72 foot.

(*b*) Measurement made under complete ice cover. Gage height to top of ice, 3.56 feet; average thickness of ice, .98 foot.

(*c*) Measurement made under partial ice cover. Gage height to top of ice, 4.42 feet; average thickness of ice, .88 foot.

(*d*) Measurement made under ice conditions.

Daily gage height, in feet, of Hudson River at North Creek, N. Y., for 1909.
[Gilbert Dean, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.87	.....	.....	.....	5.32	3.44	2.38	2.84	3.02	2.99	2.73	2.72
2	2.87	4.20	.....	.....	5.88	3.42	2.24	2.81	3.00	2.95	2.72	2.75
3	2.86	3.90	.....	.....	5.78	3.66	2.30	2.77	3.00	2.92	2.80	2.76
4	2.76	.....	.....	.....	5.60	3.67	2.35	2.73	3.00	2.89	2.80	2.68
5	2.75	3.90	.....	.....	6.00	3.42	2.37	2.74	3.01	2.78	2.80	2.62
6	3.10	.....	4.30	.....	5.32	3.95	2.26	2.74	2.97	2.72	2.79	2.52
7	3.35	.....	.....	5.35	5.80	4.12	2.28	2.87	2.95	2.70	2.82	2.52
8	3.44	.....	.....	6.48	6.98	4.03	2.36	3.06	2.96	2.78	2.95	2.42
9	3.59	.....	.....	6.35	6.04	3.78	2.30	3.06	2.94	2.92	2.95	2.29
10	3.80	4.50	.....	5.88	6.75	3.48	2.25	3.05	2.94	2.85	3.08	2.40
11	3.55	.....	.....	5.38	7.81	4.12	2.48	3.05	2.94	2.86	3.05	2.52
12	3.50	.....	.....	4.72	8.75	4.04	2.70	3.05	2.92	2.85	2.98	2.90
13	3.48	4.35	4.05	4.60	6.62	3.53	2.78	3.05	2.92	2.60	2.82	3.02
14	3.43	.....	.....	8.05	6.60	3.42	2.82	3.03	2.90	2.65	2.72	3.35
15	3.22	.....	.....	8.40	5.28	3.36	2.85	3.02	2.90	2.82	2.66	3.32
16	3.35	.....	.....	7.85	4.98	3.12	2.85	3.09	2.91	2.82	2.65	3.20
17	.....	.....	.....	7.44	5.08	3.10	2.86	3.09	2.87	2.77	2.70	3.00
18	3.40	.....	.....	7.26	5.58	3.20	2.88	3.05	2.84	2.80	3.25	2.95
19	.....	4.20	.....	6.95	5.08	4.08	3.20	2.65	2.89	2.80	2.92	2.90
20	3.40	.....	.....	7.56	4.60	3.32	3.20	2.31	2.89	2.80	2.66	2.80
21	.....	.....	.....	7.20	4.64	3.55	3.36	2.20	2.82	2.80	2.65	2.75
22	.....	.....	.....	6.48	4.98	3.08	3.42	2.16	2.85	2.80	2.65	2.74
23	.....	.....	.....	6.18	4.48	2.90	3.26	2.20	2.85	.....	2.68	2.75
24	3.57	.....	.....	5.65	4.03	2.82	3.20	2.48	2.90	.....	2.72	2.72
25	4.60	.....	.....	5.08	4.08	2.78	2.96	3.02	2.89	.....	2.86	2.72
26	4.95	5.95	4.10	5.80	3.87	2.70	2.74	3.06	2.84	2.85	3.15	2.80
27	5.15	.....	4.12	4.92	3.58	2.60	2.74	3.06	2.82	2.84	3.00	2.92
28	5.15	.....	.....	5.38	3.57	2.55	2.67	3.05	2.90	2.84	2.92	2.93
29	5.05	.....	.....	4.90	4.62	2.51	2.69	3.04	2.90	2.85	2.81	2.95
30	.....	.....	.....	4.80	4.18	2.45	2.94	3.04	2.92	2.88	2.74	3.00
31	.....	.....	3.65	.....	3.42	.....	2.90	3.04	.....	2.74	.....	3.02

NOTE.— Ice conditions prevailed January 1 to April 6 and from about December 1 to 31

Daily discharge, in second-feet, of Hudson River at North Creek, N. Y., for 1909.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	417	600	2,300	1,290	4,790	1,400	388	736	910	880	637	556
2	410	600	2,100	1,860	6,130	1,380	310	709	890	840	628	580
3	398	500	1,900	2,420	5,880	1,710	340	673	890	810	700	58
4	349	500	1,700	2,990	5,440	1,720	370	637	890	781	700	512
5	338	500	1,450	3,550	6,430	1,380	382	646	900	682	700	484
6	505	600	1,350	4,110	4,790	2,160	320	646	860	628	691	414
7	642	1,070	1,320	4,860	5,930	2,430	330	763	840	610	718	414
8	686	1,300	1,300	7,710	9,140	2,290	376	950	850	682	840	352
9	775	1,100	1,280	7,360	6,530	1,890	340	950	830	810	840	277
10	898	900	1,260	6,130	8,480	1,450	315	940	830	745	970	340
11	718	850	1,240	4,920	11,700	2,430	448	940	830	754	940	373
12	702	800	1,200	3,520	14,700	2,300	610	940	810	745	870	385
13	642	820	1,180	3,290	8,110	1,520	682	940	810	530	718	451
14	598	840	1,140	12,400	8,050	1,380	718	920	790	570	628	640
15	471	860	1,090	13,600	4,700	1,300	745	910	790	718	578	625
16	510	880	1,030	11,800	4,050	1,010	745	980	800	718	570	610
17	498	900	980	10,500	4,260	990	754	980	763	673	610	440
18	486	940	940	9,970	5,390	1,100	772	940	736	700	1,160	412
19	459	940	900	9,060	4,260	2,370	1,100	570	781	700	810	385
20	432	1,600	860	10,900	3,290	1,250	1,100	346	781	700	578	345
21	432	2,100	840	9,790	3,370	1,550	1,300	290	718	700	570	325
22	432	2,500	820	7,710	4,050	970	1,380	272	745	700	570	321
23	432	2,300	800	6,900	3,060	790	1,170	290	745	700	594	325
24	432	2,100	856	5,560	2,290	718	1,100	448	790	722	628	313
25	1,040	2,400	900	4,260	2,370	682	850	910	781	745	754	313
26	1,290	2,500	948	5,930	2,030	610	646	950	736	745	1,040	345
27	1,200	2,500	948	3,920	1,590	530	646	950	718	736	890	396
28	1,000	2,400	950	4,920	1,580	495	586	940	790	736	810	402
29	800	.....	950	3,680	3,330	467	602	930	790	745	709	412
30	700	.....	950	3,680	2,540	430	830	930	810	772	646	440
31	600	.....	950	.....	1,380	.....	790	930	.....	646	.....	451

NOTE.— Daily discharge during frozen periods determined on the basis of measurements made under ice conditions, climatalogical reports and intercomparison with the discharge obtained at other stations. A well defined rating has been used for open water period.

[illegible] Hudson River [illegible] Thurman, N. Y., for 1907, '08, '09.

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible] based on measurement under [illegible] estimates differ slightly [illegible] Annual Report of the State Water Supply Commission [illegible]

Hudson River at Thurman, N. Y.

This station is located on the Delaware and Hudson Railroad bridge leading from Thurman to Warrensburg, about [illegible] feet below the highway bridge to Warrensburg, and some 2,[illegible]00 feet below the entrance of Schroon river into the Hudson. It was established, in coöperation with the U. S. Geological Survey, September 22, 1907, to obtain general statistical and comparative data regarding the flow of the Hudson.

There is a dam on Schroon river at Warrensburg, about 3 miles above the station. On the Hudson there is a dam at Luzerne about 12 miles below. During the winter months the discharge is affected by the presence of ice, and the station discontinued.

The datum of the chain gage has remained the same during the maintenance of the station. Conditions for obtaining accurate discharge data are excellent, and a very good rating curve has been developed.

The regimen of flow of the upper Hudson, especially during the low-water season, has been considerably affected by storage in Indian Lake reservoir.

Information in regard to this station is contained in annual reports of theU. S. Geological Survey.

Discharge measurements of Hudson River at Thurman, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 21	C. C. Covert	305	1,360	4 98	6,900
Aug. 25	W. G. Hoyt	255	688	2.50	886

Daily gage height, in feet, of Hudson River at Thurman, N. Y., for 1909.

[S. H. Spencer, observer.]

DAY.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	3.52	5.22	3.75	2.85	2.44	2.63	2.61	2.35	2.48
2	......	3.68	5.57	3.43	2.83	2.46	2.62	2.64	2.38	2.51
3	......	3.77	5.51	3.64	2.79	2.46	2.59	......	2.39	2.49
4	......	3.90	5.38	3.35	2.70	2.38	2.56	2.55	2.46	2.49
5	......	4.15	5.65	3.56	2.71	2.37	2.61	2.48	2.44	......
6	......	4.41	5.58	......	2.66	2.42	2.57	2.36	2.41	2.42
7	......	6.00	6.13	4.18	2.62	2.40	2.52	2.36	2.34	2.34
8	......	6.52	6.52	4.14	2.54	2.53	2.54	2.32	2.47	2.29
9	......	6.38	5.80	3.95	2.54	2.68	2.52	2.53	2.51	2.33
10	4.35	6.18	6.08	3.76	2.56	2.70	2.54	2.48	2.48	2.28
11	4.41	5.68	6.98	4.30	2.34	2.66	2.54	2.52	2.48	3.22
12	4 07	4.42	7.92	3.79	2.66	2.67	2.53	2.48	2.42	......
13	4.11	4.44	6.39	3.62	2.64	2.67	2.54	2.34	2.38	......
14	4.03	7.96	6.28	3.54	2.73	2.65	2.52	2.19	2.40	......
15	3.91	8.45	5.52	3.57	2.74	2.63	2.52	2.43	2.41	......
16	3.74	8.10	5.34	3.34	2.74	2.72	2.51	2.47	2.42	......
17	3.65	7.82	5.44	3.28	2.73	2.79	2.52	2.22	2.53	......
18	3.53	7.78	5.66	3.42	2.62	2.82	2.51	2.38	2.41	......
19	3.43	7.34	5.34	4.06	2.68	2.64	2 40	2.34	2.41	......
20	3.43	7.75	5.03	3.58	2.70	2.74	2.52	2.34	2.42	......
21	3.23	7.37	4.93	5.41	2.97	2.38	2.46	2.34	......	......
22	3.58	6.86	5.18	3.36	3.02	......	2.44	2.40	......	......
23	3.50	6.47	4.74	3.16	2.86	2.02	2.46	2.43	......	......
24	3.57	6.11	4.48	3.15	2.85	2.00	2.54	2.40	2.40	......
25	3.66	5.55	4.32	3.08	2.72	2.58	2.47	2.48	2.25	......
26	3.85	5.77	4.17	3.04	2.52	2.66	2.42	2.45	2.76	......
27	3.83	5.22	3.82	2.96	2.44	2.68	2.48	2.44	2.69	......
28	3.67	5.39	3.64	2.92	2.47	2.67	2.63	2.44	2.64	......
29	3.58	4.99	3.71	2.97	2.34	2.66	2.58	2.42	2.65	......
30	3.48	5.25	4.44	2.85	2.50	2.64	2.58	2.37	2.64	......
31	3.48	......	3.55	......	2.56	2.64	......	......	......	......

The dam at Mechanicville was raised during 1904, a concrete crest and apron being added, so that the dam has now a rounded or ogee section. A discharge curve has been calculated, using coefficients of discharge derived from U. S. Geological Survey experiments on models of dams of ogee cross-section.

Water carried in Champlain canal, which parallels Hudson river from Fort Edward to Albany, is not included in the estimated discharge.

Daily discharge, in second-feet, of Hudson River at Mechanicville, N. Y., for 1909.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,874	6,879	15,672	11,867	18,524	7,243	2,389	1,404	1,379	1,778	1,935	1,868
2	1,589	5,690	12,458	11,485	21,185	6,618	2,293	1,785	1,578	1,753	1,549	2,550
3	1,836	4,790	12,654	12,216	21,493	5,598	2,327	1,010	1,736	1,566	1,554	1,955
4	1,887	4,436	11,452	13,753	22,566	5,362	2,682	1,463	1,665	2,274	1,470	1,601
5	1,700	3,973	10,068	14,326	23,523	5,540	2,031	1,759	674	1,501	1,472	2,105
6	10,054	6,611	8,867	15,778	21,770	6,894	2,941	1,245	1,187	1,906	1,551	1,764
7	10,269	8,057	8,001	20,423	19,817	9,564	2,401	1,213	2,140	1,711	,718	1,991
8	8,098	8,443	8,017	30,501	19,617	8,331	2,399	612	1,479	1,677	1,561	2,172
9	6,566	7,471	6,465	34,889	23,252	7,436	1,824	1,318	1,476	1,334	1,580	1,678
10	7,084	6,652	6,740	31,585	18,708	7,016	3,100	1,115	1,476	1,406	1,769	1,718
11	6,462	7,551	10,752	28,234	21,082	6,509	1,492	1,731	1,684	1,931	1,505	2,036
12	4,705	6,994	9,871	22,471	24,794	8,436	1,781	1,526	1,501	1,697	1,594	601
13	4,561	7,368	8,273	19,659	28,154	6,801	1,785	939	1,524	950	1,585	1,675
14	3,823	6,386	6,367	20,410	22,696	7,747	1,764	1,077	1,548	1,516	856	1,612
15	4,028	7,518	6,484	37,324	20,490	6,520	1,688	740	1,579	1,503	2,357	1,664
16	1,968	8,147	7,573	46,299	17,031	6,136	1,683	1,819	1,479	1,504	2,283	1,722
17	3,506	7,445	7,490	44,847	17,511	5,126	1,859	1,769	1,515	720	1,525	1,725
18	3,239	7,566	6,420	40,771	17,104	5,814	1,569	1,344	1,652	1,716	1,188	1,486
19	2,421	6,874	6,106	36,910	16,996	6,396	1,481	2,189	430	1,453	1,195	400
20	2,326	27,591	6,144	34,091	15,656	8,009	1,481	3,209	1,482	2,001	1,402	1,815
21	2,347	24,515	6,293	37,736	14,777	7,093	2,109	2,704	1,482	1,806	1,731	1,433
22	3,296	20,683	6,262	33,665	13,370	5,292	1,814	1,032	883	1,496	1,955	1,520
23	1,995	18,376	5,641	29,977	13,150	4,941	1,801	2,579	1,517	1,492	2,092	1,489
24	6,328	16,719	7,013	27,855	10,039	4,075	1,935	2,146	1,697	531	2,140	1,470
25	10,244	29,655	7,849	23,500	12,607	4,069	1,712	1,907	1,738	1,589	1,652	873
26	9,634	22,897	13,483	21,187	9,469	3,748	1,809	1,717	742	1,579	1,534	557
27	9,421	19,865	12,488	19,146	8,373	4,647	3,387	1,774	1,702	1,505	1,564	1,447
28	8,990	16,346	13,784	17,202	7,747	3,914	1,779	1,479	1,513	1,748	2,014	3,473
29	8,155	......	14,215	18,917	7,231	3,270	1,752	235	1,512	1,571	2,451	1,546
30	6,956	......	11,875	17,080	8,784	2,496	1,206	1,027	1,765	1,448	2,617	1,412
31	6,104	......	11,049	......	9,298	......	1,222	1,126	......	1,549	......	1,424

Note.— Record furnished by R. P. Bloss, C. E.

Monthly discharge of Hudson River at Mechanicville, N. Y., for 1907, '08, '09.
[Drainage area, 4,500 square miles.]

MONTH.	Discharge in Second-Feet.				Depth of run-off in inches on drainage area.
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
January	19,000	4,490	10,300	2.29	2.64
February	5,660	2,350	4,140	.920	.96
March	36,200	2,400	9,570	2.13	2.46
April	36,700	7,960	16,600	3.69	4.12
May	24,300	7,370	13,900	3.09	3.56
June	8,410	3,320	5,560	1.24	1.38
July	6,670	2,800	4,120	.916	1.06
August	3,490	1,310	2,390	.531	.61
September	10,300	3,260	6,150	1.37	1.53
October	23,600	5,190	9,560	2.12	2.44
November	31,800	6,200	14,000	3.11	3.47
December	22,800	3,490	12,000	2.67	3.08
The year	36,700	1,310	9,020	2.01	27.31
1908.					
January	18,000	2,690	8,410	1.87	2.16
February	28,300	3,210	9,690	2.15	2.32
March	32,800	6,360	14,000	3.11	3.58
April	34,300	15,500	22,300	4.96	5.53
May	32,000	6,420	17,900	3.98	4.59
June	9,170	1,770	3,760	.836	.93
July	3,250	1,480	2,140	.476	.55
August	2,260	1,280	1,770	.393	.45
September	1,590	673	1,020	.227	.25
October	2,300	1,040	1,380	.307	.35
November	3,520	454	1,850	.411	.46
December	3,660	557	2,010	.447	.52
The year	34,300	454	7,190	1.60	21.69
1909.					
January	10,300	1,590	5,210	1.16	1.34
February	29,700	3,970	11,600	2.58	2.69
March	15,700	5,640	9,220	2.05	2.36
April	46,300	11,500	25,800	5.73	6.39
May	28,200	7,230	17,000	3.78	4.36
June	9,560	2,500	6,020	1.34	1.50
July	3,390	1,210	1,980	.441	.51
August	3,210	235	1,520	.338	.39
September	2,140	430	1,460	.324	.36
October	2,270	531	1,560	.347	.40
November	2,360	718	1,680	.373	.42
December	2,550	400	1,570	.348	.40
The year	46,300	235	7,050	1.56	21.12

NOTE.— Discharge interpolated August 20 to 26, 1907, by the U. S. Geological Survey in order to complete the year.

SCHROON RIVER BASIN.

Description.

Schroon river rises in Essex county, along the southern slopes of the highest mountains in the Adirondack group, flows in a general southerly direction for about 45 miles through Essex and Warren counties, and joins the Hudson near Thurman. Its total drainage area is 550 square miles. Its headwaters reach an elevation of about 2,000 feet above mean tide, while at its mouth the elevation is about 600 feet.

Its basin is largely forested and contains considerable wild land and numerous lakes and ponds. The most important of these is Schroon lake, through which the river flows. It has a water surface area of about 6.3 square miles. The river affords excellent opportunities for storage and power development, which are under investigation by the New York State Water Supply Commission. The only power developments are at Warrensburg.

Schroon Lake, near Pottersville, N. Y.

This station is located at the outlet of Schroon lake, one mile from Pottersville post-office, and is at the steamboat wharf. It was established July 8, 1908, in co-operation with the U. S. Geological Survey, to obtain fluctuations in level of Schroon lake in connection with the gaging station on Schroon river at Riverbank, and was discontinued December 5, 1908, re-established July 1, 1909, discontinued December 4, 1909. The gage datum was established at an elevation of 803.75 feet above mean sea level. The ice raised the gage .17 during the winter of 1908–09. A correction of .17 has been applied to the 1909 readings.

Information in regard to this station is contained in annual reports of the U. S Geological Survey.

Daily gage height, in feet, of Schroon Lake at Pottersville, N. Y., for 1909.
[Asel Galusha, observer.]

DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.87	1.57	1.87	1.77	1.57	1.27	17	.87	1.67	1.57	1.67	1.37	......
2	2.67	1.57	1.87	1.77	1.57	1.27	18	.87	1.67	1.57	1.57	1.37	......
3	2.47	1.62	1.87	1.77	1.57	1.27	19	.97	1.72	1.57	1.57	1.42	......
4	2.37	1.67	1.87	1.77	1.62	1.27	20	.97	1.77	1.57	1.57	1.47	......
5	2.17	1.67	1.87	1.77	1.62	......	21	1.17	1.82	1.57	1.57	1.47	......
6	1.97	1.67	1.82	1.77	1.67	......	22	1.17	1.82	1.57	1.57	1.47	......
7	1.87	1.67	1.77	1.77	1.67	......	23	1.27	1.87	1.57	1.57	1.47	......
8	1.67	1.67	1.77	1.77	1.62	......	24	1.37	1.87	1.57	1.62	1.42	......
9	1.57	1.67	1.82	1.77	1.62	......	25	1.37	1.87	1.57	1.62	1.37	......
10	1.37	1.57	1.72	1.77	1.57	......	26	1.47	1.77	1.57	1.62	1.32	......
11	1.27	1.57	1.72	1.82	1.57	......	27	1.47	1.77	1.52	1.62	1.32	......
12	1.17	1.47	1.62	1.82	1.57	......	28	1.47	1.77	1.57	1.57	1.32	......
13	1.07	1.47	1.62	1.77	1.57	......	29	1.47	1.82	1.67	1.57	1.27	......
14	.97	1.57	1.62	1.77	1.52	......	30	1.47	1.82	1.77	1.57	1.27	......
15	.97	1.57	1.57	1.77	1.47	......	31	1.57	1.87	......	1.57	......	......
16	.87	1.57	1.57	1.77	1.47	......	......	......	......	......	......	......	......

Schroon River at Riverbank, N. Y.

This station is located on the steel highway bridge near Riverbank post-office, between the towns of Warrensburg and Bolton, about 9 miles north of the village of Warrensburg, and about 10 miles downstream from the outlet of Schroon lake. It was established September 23, 1907, in co-operation with the U. S. Geological Survey, to obtain general statistical data in regard to the flow of Schroon river.

There are several dams at the village of Warrensburg used for power purposes. During September, 1907, a timber crib dam was constructed at Starbuckville, about 6 miles above the gaging station for storage purposes, this affording a head of some 8 feet and ponding water to Schroon lake. Tumblehead falls begin about one mile above the gaging station and extend upstream for about a mile further, affording a total fall of some 30 feet.

The datum of the gage has remained the same during the maintenance of the station. During the winter months the discharge is affected by ice conditions. Conditions for obtaining accurate discharge are good, and a very good rating curve has been developed.

Since 1907 the regimen of flow of Schroon river during the low water season has been considerably affected by the storage held in Schroon lake.

Information in regard to this station is contained in the annual reports of the U. S. Geological Survey.

Discharge measurements of Schroon River at Riverbank, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. Ft.*	*Feet.*	*Sec.-ft.*
Jan. 21....	C. R. Adams......................	65	150	2.11	(*a*)287
June 18....	Covert and Cooper................	75	260	3.28	1,040
Dec. 11....	Hoyt and James...................	64	193	1.71	(*b*)184

(*a*) River under partial ice cover. Gage height to top of ice, 2.22 feet; average thickness of ice, .67 feet.

(*b*) Ice along the shores affected the measurement.

Daily gage height, in feet, of Schroon River at Riverbank, N. Y., for 1909.
[J. H. Roberts, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.50	......	4.21	3.17	4.62	3.28	2.95	1.15	1.15	1.30	1.30	1.85
2	1.55	2.95	3.96	3.32	4.57	3.13	2.95	1.15	1.10	1.15	1.45	1.80
3	1.40	3.00	3.81	3.42	4.72	3.13	2.80	1.10	1.20	1.35	1.50	1.80
4	......	3.00	3.76	3.42	4.82	3.03	2.70	1.30	1.10	1.35	1.50	1.75
5	1.55	......	3.61	3.82	4.72	3.38	2.65	1.30	1.10	1.35	1.45	1.75
6	......	2.95	3.46	3.82	4.62	3.63	2.60	1.30	1.10	1.35	1.45	1.70
7	1.80	......	3.41	4.42	4.72	4.08	2.55	1.35	1.15	1.40	.95	1.70
8	......	2.70	3.46	5.77	4.98	4.03	2.45	1.15	1.15	1.30	1.55	1.70
9	2.00	......	3.51	6.47	5.03	3.83	2.40	1.25	1.10	1.30	1.45	1.70
10	2.00	2.95	3.71	6.50	5.03	3.83	2.30	1.25	1.10	1.25	1.50	1.70
11	2.10	......	3.21	6.32	5.48	3.78	2.10	1.30	1.15	1.30	1.45	1.70
12	......	2.71	3.51	5.97	6.03	3.68	2.20	1.20	1.10	1.00	1.40	1.75
13	2.05	2.76	3.41	5.87	6.03	3.48	2.20	1.20	1.35	1.50	1.45	1.75
14	......	......	3.31	6.37	5.83	3.63	2.10	1.20	1.30	1.50	1.00	1.70
15	2.10	2.81	3.26	8.12	5.58	3.53	2.10	1.15	1.25	1.50	1.40	1.70
16	2.10	......	3.21	8.67	5.53	3.63	2.00	1.30	1.30	.95	1.50	1.70
17	......	2.96	3.11	8.34	5.58	3.03	1.90	1.20	1.30	.85	1.65	1.70
18	2.10	......	3.01	8.12	5.53	3.33	1.20	1.25	1.35	1.05	1.55	1.65
19	......	2.96	2.96	7.97	5.33	3.20	1.35	1.20	1.40	.90	1.50	1.60
20	2.25	3.21	2.96	7.77	5.28	3.10	1.50	1.20	1.30	1.00	1.50	1.70
21	2.[illegible]1	3.41	2.81	7.57	5.13	3.15	1.20	1.15	1.30	1.3[illegible]	1.50	1.70
22	1.95	3.36	2.81	7.34	4.98	3.05	1.25	1.10	1.25	1.30	1.50	1.50
23	2.10	3.51	2.71	6.94	4.83	3.30	1.30	1.25	1.25	1.30	1.55	1.60
24	2.25	3.91	2.71	6.47	4.58	3.20	1.30	1.30	1.30	1.30	1.50	1.60
25	2.20	3.96	2.81	6.12	4.38	3.05	1.20	1.20	1.30	1.25	1.60	1.60
26	2.10	4.51	3.02	5.77	4.38	3.00	1.20	1.20	1.20	1.25	1.80	......
27	......	4.21	2.97	5.42	3.43	2.90	1.25	1.20	1.20	1.30	1.85	1.60
28	2.50	4.21	3.02	5.22	3.43	3.20	1.15	1.15	1.50	1.30	1.85	1.60
29	2.85	......	3.07	4.97	3.53	3.00	1.15	1.15	1.40	1.30	1.95	1.60
30	2.95	......	3.12	4.72	3.38	3.00	1.25	1.15	1.40	1.10	1.95	1.60
31	2.90	......	3.12	......	3.38	......	1.20	1.20	......	1.05	......	1.60

NOTE.— Ice conditions prevailed from about January 1 to February 12 and December 12 to 31.

Daily discharge, in second-feet, of Schroon River at Riverbank, N. Y., for 1909 .

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	130	300	1,890	946	2,350	1,030	806	86	86	122	122	294
2	140	300	1,630	1,060	2,290	920	806	86	74	86	164	276
3	110	300	1,480	1,140	2,470	920	721	74	97	136	178	276
4	130	300	1,440	1,140	2,580	855	668	122	74	136	178	250
5	140	420	1,300	1,490	2,470	1,100	643	122	74	136	164	250
6	170	550	1,170	1,490	2,350	1,320	618	122	74	136	164	242
7	200	500	1,130	2,120	2,470	1,760	593	136	86	149	44	242
8	220	480	1,170	3,720	2,780	1,710	545	86	86	122	194	242
9	255	500	1,210	4,560	2,840	1,500	522	110	74	122	164	242
10	255	550	1,390	4,600	2,840	1,500	476	110	74	110	178	242
11	284	600	973	4,380	3,380	1,460	390	122	86	122	164	242
12	280	650	1,210	3,900	4,040	1,360	432	97	74	53	149	250
13	270	700	1,130	3,840	4,040	1,180	432	97	136	178	164	250
14	280	713	1,050	4,440	3,820	1,320	390	97	122	178	53	242
15	284	726	1,010	6,540	3,500	1,230	390	86	110	178	149	242
16	284	769	973	7,200	3,440	1,320	350	122	122	44	178	242
17	284	812	907	6,930	3,500	855	312	97	122	28	226	242
18	284	812	842	6,540	3,440	1,060	97	110	136	61	194	226
19	300	812	812	6,300	3,200	966	136	97	149	35	178	210
20	330	973	812	6,120	3,140	900	178	97	122	53	178	200
21	287	1,130	726	5,880	2,960	933	97	86	122	122	178	190
22	241	1,090	726	5,610	2,780	868	110	74	110	122	178	178
23	184	1,210	673	5,130	2,600	1,040	122	110	110	122	194	170
24	331	1,580	673	4,560	2,300	966	122	122	122	122	178	165
25	315	1,630	726	4,140	2,080	868	97	97	122	110	210	165
26	284	2,230	849	3,720	2,080	836	97	97	97	110	276	165
27	29	1,890	818	3,300	1,140	776	110	97	97	122	294	163
28	300	1,890	849	3,060	1,140	966	86	86	178	122	294	160
29	350	......	881	2,760	1,280	836	86	86	149	122	331	160
30	350	......	913	2,470	1,100	836	110	86	149	74	331	160
31	350	......	913	.	1,100	.....	97	97	......	61	......	160

NOTE.— Daily discharge during the period of ice conditions estimated on the basis o two measurements made under ice cover. Discharge during the open period based on a rating which is well defined below gage height 6 feet.

Monthly discharge of Schroon River at Riverbank, N. Y., for 1907, '08, '09.

[Drainage area, 534 square miles.]

MONTH.	Discharge in Second-Feet.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
September	476	(*a*)48	184	0.345	0.38	A
October	721	236	545	1.02	1.18	A
November	3,860	668	1,530	2.87	3.20	A
December	1,840	568	1,130	2.12	2.44	A
1908.						
January	1,780	694	(1,010)	1.89	2.18	C
February	1,570	721	(1,130)	2.12	2.29	C
March	3,640	836	(1,300)	2.43	2.80	C
April	4,480	1,990	3,160	5.92	6.60	A
May	4,300	1,380	2,790	5.22	6.02	A
June	......	276	700	1.31	1.46	B
July	1,200	97	335	.627	.72	B
August	207	83	117	.219	.25	A
September	273	49	160	.300	.33	A
October	236	40	159	.298	.34	A
November	283	39	195	.365	.41	A
December	237	144	(198)	.371	.43	C
The year	4,480	39	938	1.76	23.83	
1909.						
January	350	110	(255)	.478	.55	C
February	2,230	300	(872)	1.63	1.70	C
March	1,890	673	(1,040)	1.95	2.25	B
April	7,200	946	3,970	7.43	8.29	A
May	4,040	1,100	2,630	4.93	5.68	A
June	1,760	776	1,110	2.08	2.32	A
July	806	86	343	.642	.74	A
August	136	74	100	.187	.22	A
September	178	74	108	.202	.23	A
October	178	28	110	.206	.24	A
November	331	44	188	.352	.39	A
December	294	160	(218)	.408	.47	C
The year	7,200	28	912	1.71	23.08	

(*a*) Not natural flow.

NOTE.—(1908) Discharge January–March may be slightly too high on account of ice conditions below station. July is somewhat too high on account of log jams. June has been corrected approximately on account of log jams. Discharge December 6–31, 196 second-feet, estimated on the basis of a measurement made December 31st, under ice conditions.

SACANDAGA RIVER BASIN.

Description.

Sacandaga River is formed by three principal branches which unite in the south-eastern part of Hamilton county in the Adirondack region. The West branch is the outlet of Piseco Lake, the Middle branch is the outlet of Sacandaga and Pleasant lakes, while the East and principal branch issues from a series of small ponds and lakes in the southwestern part of Warren county. The East and Middle branches unite a few miles north of Wells and are joined by the West branch a short distance below Wells. The river then flows southeasterly to about 5 miles below Northville, where it turns and runs northeasterly to the Hudson, at Hadley. Its total drainage area comprises about 1,050 square miles.

Sacandaga Lake, the highest of the tributary lakes in the headwaters, is about 1,700 feet above mean tide; at its entrance into the Hudson the Sacandaga is at an elevation of about 550 feet. Between Northville and the mouth of the river there is a fall of about 180 feet (chiefly concentrated in the 5 miles below Conklingville) entirely unutilized. There are, in fact, no power developments on the Sacandaga.

The drainage area of this river is largely in forest. Precipitation is high, the mean for the year being about 49 inches, whereas that of the whole Hudson drainage area above Mechanicville is only about 43 inches. Possibilities for storage on the Sacandaga are great and the State Water Supply Commission of New York propose a high earth rock-fill dam at Conklingville, the reservoir storing about 25 billion cubic feet of water, with a water surface of about 40 square miles, and controlling practically the entire flow of the Sacandaga basin. Their plan proposes also to develop the total fall obtained between Conklingville and the Hudson — approximately 200 feet — which will afford 25,000 to 30,000 continuous horsepower.

Sacandaga River at Wells, N. Y.

This station is located on the steel highway bridge over the east branch of the Sacandaga river in the southern part of the village of Wells, about 2½ miles above the junction of the East and West branches. It was established August 26, 1907, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of the Sacandaga river.

The gage datum has remained the same during the maintenance of the station During the winter months the discharge is usually affected by the presence of ice Conditions for obtaining the accurate discharge are good, and a fairly good rating curve has been developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Sacandaga River at Wells, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. Ft.*	*Feet.*	*Sec.-ft.*
Jan. 23....	C. R. Adams......................	68	184	5.10	(*a*)174
Feb. 10....	C. R. Adams......................	70	238	5.92	(*b*)637
June 30....	C. C. Covert......................	77	120	4.28	124
June 30....	C. C. Covert......................	77	150	4.29	133

(*a*) River obstructed by ice. Partial ice cover. Average thickness of ice, 0.6 foot Gage height to top of ice, 5.20 feet.

(*b*) Discharge affected by ice conditions.

Daily gage height, in feet, of Sacandaga River at Wells, N. Y., for 1909.
[Roscoe R. Stanyon, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.49	5.88	6.08	5.32	6.82	5.32	4.22	3.86	3.70	3.85	3.76	4.09
2	4.48	5.85	5.85	5.48	7.70	5.28	4.19	3.81	3.70	3.80	3.76	4.07
3	4.45	5.95	5.68	5.85	6.85	5.18	4.42	3.81	3.69	3.76	3.76	4.02
4	4.49	5.85	5.58	5.95	7.30	5.18	4.34	3.79	3.68	3.74	3.78	4.02
5	4.65	5.68	5.55	5.90	6.85	5.35	4.24	3.78	3.70	3.72	3.80	3.98
6	6.85	5.42	5.52	6.48	7.70	6.12	4.19	3.77	3.70	3.71	3.80	4.02
7	6.28	6.72	5.38	8.52	8.98	5.80	4.14	3.76	3.68	3.70	3.75	4.05
8	5.98	6.48	5.35	8.92	7.78	5.45	4.09	3.75	3.66	3.68	3.71	4.00
9	5.95	6.25	5.32	8.38	6.52	5.25	4.06	3.74	3.64	3.66	3.67	4.10
10	5.82	6.42	5.20	7.48	7.75	5.28	4.04	3.74	3.66	3.66	3.68	4.32
11	5.78	6.72	5.28	6.68	8.55	5.78	4.02	3.72	3.70	3.67	3.75	4.12
12	5.42	6.40	5.26	6.52	7.55	5.40	3.99	3.71	3.68	3.68	3.78	4.08
13	5.30	6.10	5.19	7.28	7.38	5.35	3.95	3.70	3.67	3.69	3.78	4.08
14	5.41	5.82	5.24	10.38	7.42	5.38	3.94	3.70	3.65	3.70	3.78	4.23
15	5.58	5.70	5.28	9.58	7.20	5.22	3.94	3.75	3.64	3.71	3.78	4.2
16	5.65	6.44	5.30	8.75	6.85	4.98	3.91	3.88	3.64	3.75	3.78	4.28
17	6.05	6.35	5.18	8.40	6.42	4 82	3.94	4.25	3.62	3.78	3.84	4.30
18	6.08	6.08	5.12	8.68	6.15	4.98	3.95	4.28	3.62	3.78	3.88	4.30
19	6.06	6.15	5.22	8.68	6.25	5.02	3.96	4.20	3.62	3.78	3.90	4.23
20	5.96	8.02	5.15	9.58	6.22	5.15	3 94	4.08	3.62	3.78	3.92	4.25
21	6.14	8.18	5.05	8.08	6.18	4.98	3.94	4.00	3.61	3.76	3.94	4.24
22	6.00	7.68	5.05	8.92	6.05	4.82	3.96	3.96	3.60	3.92	3.94	4.22
23	5.22	6.82	5.05	8.70	5.75	4.72	4.12	3.94	3.60	3.98	4.10	4.18
24	5.28	6.55	5.02	8.50	5.45	4.62	4.28	3.88	3.70	3.91	4.21	4.18
25	7.28	7.85	4.98	7.50	5.38	4.54	4 31	3.79	3.72	3.86	4.21	4.14
26	6.85	7.00	5.18	7.88	5.42	4.48	4.22	3.75	3.72	3.84	4.26	4.12
27	6.43	6.48	5.16	8.40	5.42	4.45	4.08	3.74	3.74	3.84	4.38	4.18
28	6.09	6.42	5.22	8.50	5.48	4.40	4.00	3.71	3.80	3.80	4.25	4.18
29	6.02	......	5.28	8.58	5.52	4.31	3.96	3.72	3.86	3.82	4.15	4.12
30	5.72	......	5.16	7.35	5.42	4.24	3.92	3.70	3.88	3.75	4.12	4.12
31	5.56	......	5.18	......	5.36	......	3.91	3.70	......	3.76	......	4.12

NOTE.— December 18 gage height to top of ice 4.35 thickness of ice at gage 0.25. December 25 gage height to top of ice 4.30, thickness of ice at gage 0.42 feet.

Ice conditions prevailed from about January 6 to February 28 and December 13 to 31.

Gage heights April 20 to 29 affected about .5 foot by back water from log jam.

Daily discharge, in second-feet, of Sacandaga River at Wells, N. Y., for **1909.**

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	192	300	1,170	552	2,090	552	120	44	24	42	31	90
2	189	300	945	650	3,490	528	113	36	24	35	31	85
3	180	300	804	945	2,130	470	171	36	23	31	31	74
3	192	300	726	1,040	2,820	470	150	34	23	28	33	74
5	242	300	705	990	2,130	570	125	33	24	25	35	66
6	1,050	300	684	1,030	3,490	1,210	113	32	24	25	35	74
7	700	1,000	588	4,880	5,670	900	101	31	23	24	30	81
8	500	800	570	5,560	3,630	635	90	30	21	23	25	70
9	500	700	552	4,650	1,090	510	83	28	20	21	22	92
10	400	640	516	3,120	3,580	528	79	28	21	21	23	145
11	440	800	528	1,890	4,940	884	74	25	24	22	36	97
12	310	700	516	1,690	3,240	600	68	25	23	23	33	88
13	230	600	475	2,790	2,950	570	59	24	22	23	33	76
14	300	550	504	8,050	3,010	588	58	24	20	24	33	65
15	360	650	528	6,690	2,600	492	58	30	20	25	33	65
16	390	700	540	5,280	2,130	372	52	47	20	25	33	65
17	340	600	470	4,680	1,500	308	58	123	18	33	41	65
18	300	600	440	5,160	1,240	372	59	135	18	33	47	65
19	260	500	492	5,160	1,300	390	62	115	18	33	50	65
20	230	1,500	455	5,840	1,320	455	58	88	18	33	54	65
21	200	2,800	405	3,200	1,280	372	58	70	18	31	58	65
22	175	2,250	405	4,710	1,140	308	62	62	17	54	58	65
23	175	1,350	405	4,340	800	268	97	58	17	66	92	65
24	250	1,120	390	4,000	635	232	135	47	24	52	118	65
25	1,400	2,400	372	2,350	588	207	142	34	25	44	118	65
26	1,400	1,600	470	2,950	614	189	120	30	25	41	130	65
27	1,000	1,200	460	3,830	614	180	88	28	28	41	160	65
28	700	1,200	492	4,000	656	165	70	25	35	35	128	65
29	600	......	528	4,140	684	142	62	25	44	38	103	65
30	500	......	460	2,900	614	125	54	24	47	30	97	65
31	400	......	470	.....	576	......	52	24	......	31	......	65

NOTE.— Daily discharge during the periods of ice conditions based on measurements made under ice cover, climatological reports, and on intercomparison of discharge of Sacandaga river stations.

Daily discharge during open period based on a fairly well defined rating below 8 feet.

Monthly discharge of Sacandaga River at Wells, N. Y., for 1907, '08, '09.
[Drainage area, 263 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
August 25–31	26	24	25	0.095	0.02	C
September	820	26	185	.703	.78	B
October	2,000	186	518	1.97	2.27	B
November	4,260	405	1,120	4.26	4.75	B
December	......	......	(800)	3.04	3.50	C
1908.						
January	......	242	(450)	1.71	1.97	C
February	5,290	......	(862)	3.28	3.54	C
March	4,950	360	997	3.79	4.37	C
April	6,010	954	3,140	11.90	13.28	A
May	7,940	492	2,050	7.79	8.98	A
June	820	90	297	1.13	1.26	B
July	171	35	73.6	.280	.32	B
August	58	17	32.1	.122	.14	C
September	120	9	18.7	.071	.08	C
October	280	24	71.2	.271	.31	B
November	405	54	121	.460	.51	B
December	564	106	266	1.01	1.16	D
The year	7,940	9	698	2.65	35.92	
1909.						
January	1,400	175	(457)	1.74	2.01	D
February	2,800	300	(931)	3.54	3.69	D
March	1,170	372	(550)	2.09	2.41	A
April	8,050	552	3,590	13.70	15.29	B
May	5,670	576	2,040	7.76	8.95	A
June	1,210	125	453	1.72	1.92	B
July	171	52	86.8	.330	.38	B
August	135	24	45.2	.172	.20	C
September	47	17	23.7	.090	.10	C
October	66	21	32.7	.124	.14	C
November	160	22	58.2	.221	.25	C
December	145	65	(73.6)	.280	.32	D
The year	8,050	17	695	2.65	35.66	

NOTE.— Discharge December 15, 1907, to February 14, 1908, estimated on basis of general run-off conditions in the upper Hudson drainage basin. Discharge December 15–31, 1907, 939 second-feet. Discharge February 1–14, 1907, 250 second-feet.

Sacandaga River at Northville, N. Y.

This station is located about ¾ mile upstream from the steel highway bridge at Northville, and was established August 26, 1907. It has been maintained in cooperation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the flow of the Sacandaga.

This station is located about 1 mile below the outlet of East Stony creek and about 2 miles below West Stony creek. It is about 1¼ miles above a low storage dam at Sacandaga park in Northville. Pondage from this dam extends to the highway bridge at certain stages.

The datum of the gage has remained the same during the maintenance of the station. The U. S. Weather Bureau maintains a river and flood station at the steel highway bridge. During the winter months the discharge is usually affected by the presence of ice to such an extent that gage readings are discontinued. Conditions for obtaining the accurate discharge for the remainder of the year are very good and an excellent rating curve has been developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey and of the State Engineer and Surveyor, State of New York.

Discharge measurements of Sacandaga River at Northville, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. Ft.*	*Feet.*	*Sec.-ft.*
Feb. 11*b*...	C. R. Adams..........................	250	1,120	6.80	2,330
Feb. 27*c*...	D. M. Wood..........................	225	1,900	8.33	4,740
April 16*d*...	C. C. Covert..........................	284	2,180	7.95	12.200
April 17*d*...	C. C. Covert..........................	270	2,180	7.70	11,600

b Measurement made under complete ice cover, average thickness of ice 1.90 feet. Gage height to top of ice 6.90 feet.

c Measurement made under complete ice cover, average thickness of ice 2.10. Gage height to top of ice 8.43 feet, anchor ice running.

d Measurement made from highway bridge.

Daily gage height, in feet, of Sacandaga River at Northville, N. Y., for 1909.

[E. E. Parkes, observer.]

DAY.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	4.62	5.65	2.90	1.40	1.00	.88	1.00	1.10	2.15
2	......	4.60	6.42	2.85	1.40	.95	.82	.98	1.15	2.35
3	......	4.75	5.55	2.62	1.48	1.00	.80	1.00	1.25	2.00
4	......	4.70	5.98	2.55	1.55	.92	.80	.92	1.20	1.80
5	......	4.40	5.50	2.55	1.42	.90	.85	.90	1.10	1.65
6	......	5.00	5.50	4.00	1.32	.90	.88	.91	1.10	1.42
7	......	7.60	5.38	3.48	1.30	.95	.88	.98	1.00	1.48
8	......	8.80	5.28	3.10	1.32	.92	.80	.88	1.08	1.40
9	......	7.62	4.80	2.80	1.15	.88	.80	.95	1.10	1.42
10	......	7.00	5.28	2.60	1.10	.82	.82	.88	1.15	1.45
11	......	5.45	7.28	3.70	1.10	.80	.90	.82	1.12	1.50
12	......	4.72	6.52	3.38	1.10	.90	.80	.85	1.10	......
13	......	5.40	5.62	2.98	1.75	.80	.80	.90	1.10	......
14	......	10.25	5.25	3.48	1.00	.78	.78	.91	1.10	......
15	......	10.40	4.62	3.18	1.00	.70	.80	.90	1.10	......
16	......	8.55	4.52	2.90	1.12	.85	.85	.88	1.10	......
17	......	7.70	4.78	2.40	1.12	2.38	.80	1.10	1.10	......
18	......	7.60	4.52	3.18	1.72	2.00	.78	1.20	1.15	......
19	......	7.75	4.30	3.35	1.10	2.10	.75	1.16	1.20	......
20	......	10.50	4.30	3.10	1.00	1.70	.78	1.16	1.30	......
21	......	7.58	4.00	2.80	1.50	1.50	.72	1.10	1.35	......
22	......	7.75	3.70	2.32	1.10	1.32	.60	1.58	1.40	......
23	......	7.25	3.50	2.20	1.10	1.20	.70	1.50	1.80	......
24	......	6.40	3.32	2.10	1.80	1.18	.90	1.55	1.90	......
25	......	6.22	3.25	2.50	1.70	1.50	.88	1.55	2.00	......
26	......	6.00	3.20	2.00	1.52	1.75	.80	1.50	1.90	......
27	......	5.68	3.00	1.82	1.40	1.00	.80	1.48	1.80	......
28	4.75	5.58	3.25	1.75	1.20	1.00	1.25	1.42	1.85	......
29	4.72	5.45	3.32	1.65	1.15	.78	1.00	1.30	1.75	......
30	4.75	6.00	3.50	1.55	1.50	.85	1.10	1.25	2.10	......
31	4.80	....	3.25	....	1.50	.90	......	1.15	......	......

Note.—On account of unfavorable conditions during ice period gage heights are not taken in winter months. Ice conditions prevailed from about January 1 to March 28 and November 23 to December 31.

Daily discharge, in second-feet, of Sacandaga River at Northville, N. Y., for 1909.

DAY.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3,900	5,950	1,400	245	112	83	112	140
2	3,860	7,760	1,340	245	100	69	107	155
3	4,130	5,730	1,100	281	112	65	112	188
4	4,040	6,700	1,040	315	92	65	92	170
5	3,520	5,620	1,040	254	87	76	87	140
6	4,600	5,620	2,910	213	87	83	90	140
7	11,200	5,370	2,120	205	100	83	107	112
8	15,200	5,160	1,630	213	92	65	83	134
9	11,200	4,220	1,290	155	83	65	100	140
10	9,350	5,160	1,080	140	69	69	83	155
11	5,520	10,200	2,440	140	65	87	69	146
12	4,080	8,010	1,980	140	87	65	76	140
13	5,410	5,880	1,490	425	65	65	87	140
14	20,500	5,100	2,120	112	61	61	90	140
15	21,100	3,900	1,730	112	47	65	87	140
16	14,300	3,720	1,400	146	76	76	83	140
17	11,500	4,180	900	146	883	65	140	140
18	11,200	3,720	1,730	407	590	61	170	155
19	11,600	3,360	1,940	140	660	56	158	170
20	21,500	3,360	1,630	112	395	61	158	205
21	11,100	2,890	1,290	290	290	51	140	225
22	11,600	2,440	832	140	213	32	330	245
23	10,100	2,150	735	140	170	47	290	250
24	7,710	1,910	660	455	164	87	315	250
25	7,270	1,820	990	395	290	83	315	250
26	6,750	1,750	590	300	425	65	290	250
27	6,020	1,510	468	245	112	65	281	250
28	5,800	1,820	425	170	112	188	254	250
29	5,520	1,910	368	155	61	112	205	250
30	6,750	2,150	315	290	76	140	188	250
31	....	1,820	....	290	87	....	155	....

Note.—Daily discharge based on a well defined rating.

Monthly discharge of Sacandaga River at Northville, N. Y., for 1907, '08, '09.

[Drainage area, 740 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
August 24-31	83	69	78.2	0.106	0.03	B
September	2,070	74	550	.743	.83	B
October	7,000	632	2,000	2.70	3.11	A
November	18,400	972	3,420	4.62	5.16	A
December	10,800	750	(3,050)	4.12	4.75	C
1908.						
January	......	......	(1,430)	1.93	2.22	C
February	......	......	(2,660)	3.59	3.87	C
March	......	......	(2,880)	3.89	4.48	C
April	18,900	......	(9,600)	13.0	14.50	C
May	16,600	1,650	6,040	8.16	9.41	C
June	3,070	205	862	1.16	1.29	C
July	799	112	252	.341	.39	A
August	290	65	144	.195	.22	A
September	330	36	63.9	.086	.10	B
October	783	80	208	.281	.32	A
November	1,170	158	389	.526	.59	A
December	......	......	(446)	.603	.70	C
The year	18,900	36	2,080	2.81	38.09	
1909.						
January	......	......	(1,130)	1.53	1.76	C
February	......	......	(2,650)	3.58	3.73	C
March	......	......	(1,580)	2.14	2.47	C
April	21,500	3,520	9,210	12.4	13.83	A
May	10,200	1,510	4,220	5.70	6.57	A
June	2,910	315	1,300	1.76	1.96	A
July	455	112	226	.305	.35	A
August	883	47	189	.255	.29	A
September	188	32	75.2	.102	.11	B
October	330	69	157	.212	.24	A
November	250	112	182	.246	.27	B
December	......	......	(250)	.338	.40	D
The year	21,500	32	1,760	2.38	31.98	

Note.—Discharge January-April, 1908, and December 1907 and 1908, also missing days 1907, estimated on basis of Sacandaga at Hadley. Values for April and May are probably somewhat large.

Discharge December 5-9, 1907, 770 second-feet.

Discharge December 15-23, 1907, 1,840 second-feet.

Estimates for 1907-08 have been revised and differ slightly from those published in the fourth annual report of the State Water Supply Commission of New York.

Note.—Monthly discharge for January, February, March and December, 1909, determined rom discharge at Wells and Hadley.

Sacandaga River near Hadley, N. Y.

This station is located on the steel highway bridge about 2½ miles west of Hadley (where the Sacandaga enters the Hudson), between the towns of Corinth and Hadley. It was established September 13, 1908, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of the Sacandaga, which has important storage and power possibilities.

The nearest dam is at Conklingville about 3½ miles upstream, and is partially washed away and not used at present. Occasional log jams occur in the vicinity of this station, causing backwater. The discharge is somewhat affected by the presence of ice during the winter months.

The datum of the gage has remained the same during the maintenance of the station. Conditions for obtaining the accurate discharge are fair, except during the existence of log jams. The rating curve is fairly well developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Sacandaga River at Hadley, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. Ft.*	*Feet.*	*Sec.-ft.*
Jan. 19....	C. R. Adams..................	98	575	7.18	(*a*)913
Feb. 8....	C. R. Adams..................	118	815	7.35	(*b*) (*c*)3,350
Mar. 1....	D. M. Wood..................	288	1,820	7.30	(*c*)7,220
Mar. 26....	C. C. Covert..................	129	868	3.70	(*b*)(*d*)3,378
April 15....	C. C. Covert..................	274	1,470	6.45	14,900
April 17....	E. F. Weeks..................	285	1,780	7.46	15,500
April 19....	E. F. Weeks..................	289	1,520	6.55	19,720
May 8....	E. F. Weeks..................	282	1,000	4.70	7,680
May 10....	E. F. Weeks..................	282	986	4.62	6,740
May 20....	C. C. Covert..................	254	954	4.45	5,880
June 17....	C. C. Covert..................	121	715	2.90	(*b*)1,770
July 21....	W. G. Hoyt..................	99	482	1.50	(*b*)365
July 21....	W. G. Hoyt..................	96	468	1.50	(*b*)355
Sept. 24....	W. G. Hoyt..................	92	213	1.20	(*b*)237
Dec. 13....	Hoyt and James..............	123	565	2.59	(*b*) (*e*)407

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[a] Measurement made under partial ice cover, about 15 feet wide along shore. Very little flow under ice.

[b] Measurement made at lower bridge; all other measurements made at upper highway bridge.

[c] Measurement greatly affected by ice and logs.

[d] Discharge slightly affected by log jam.

[e] Measurement made under partial ice cover, about 40 feet wide along shore. Large amount of slush ice running.

Daily gage height, in feet, of Sacandaga River at Hadley, N. Y., for **1909.**

[W. W. Jeffers, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.60	6.40	6.60	3.90	5.20	3.00	1.68	1.50	1.20	1.45	1.45	2.00
2	2.65	6.32	6.10	4.00	5.15	2.96	1.60	1.45	1.15	1.40	1.45	2.00
3	2.70	6.30	5.55	4.10	5.10	2.88	1.68	1.40	1.15	1.35	1.40	1.95
4	2.70	6.25	4.90	4.18	5.00	2.80	1.70	1.40	1.10	1.35	1.40	1.82
5	2.90	6.20	4.20	4.40	4.90	2.80	1.65	1.35	1.10	1.30	1.35	1.80
6	3.90	6.12	3.65	4.70	4.90	2.85	1.60	1.30	1.10	1.30	1.32	1.80
7	......	6.00	3.50	5.10	4.82	2.90	1.55	1.25	1.10	1.25	1.30	1.75
8	......	6.15	3.45	5.50	4.80	2.92	1.50	1.20	1.15	1.25	1.40	1.70
9	......	6.35	3.40	5.92	4.72	2.98	1.50	1.20	1.15	1.20	1.40	1.65
10	......	6.85	3.30	6.15	4.62	3.00	1.45	1.15	1.20	1.20	1.40	1.65
11	......	6.75	3.20	5.95	4.70	3.50	1.40	1.12	1.20	1.20	1.45	1.60
12	......	6.45	3.12	6.20	4.85	3.12	1.35	1.10	1.20	1.25	1.45	1.60
13	......	6.25	3.75	6.55	5.30	3.20	1.35	1.10	1.20	1.25	1.45	1.65
14	......	6.00	2.95	6.85	5.15	3.15	1.35	1.05	1.25	1.25	1.40	1.70
15	......	6.20	2.90	7.15	4.95	3.08	1.40	1.05	1.25	1.30	1.40	1.78
16	......	6.35	2.78	7.35	4.80	2.92	1.40	1.15	1.25	1.30	1.40	1.82
17	......	6.40	2.70	7.45	4.72	2.90	1.45	1.45	1.25	1.32	1.40	1.88
18	......	6.50	2.60	7.10	4.68	2.95	1.45	2.15	1.25	1.35	1.45	1.92
19	7.17	6.60	2.55	6.90	4.45	3.02	1.50	2.30	1.20	1.40	1.50	2.00
20	7.15	6.80	2.50	6.75	4.45	3.10	1.50	2.15	1.15	1.40	1.58	2.10
21	7.15	......	2.50	6.58	4.25	3.25	1.48	1.95	1.10	1.45	1.60	2.18
22	7.10	......	2.50	6.45	4.00	2.88	1.45	1.88	1.05	1.50	1.65	2.32
23	7.10	......	2.65	6.15	3.82	2.65	1.50	1.80	1.12	1.58	1.70	2.40
24	7.10	......	2.85	5.95	3.80	2.48	1.58	1.72	1.20	1.75	1.75	2.52
25	7.45	......	3.25	5.85	3.70	2.38	1.75	1.68	1.25	1.75	1.82	2.62
26	8.50	11.35	3.70	5.78	3.62	2.25	1.88	1.58	1.25	1.70	1.92	2.82
27	8.20	11.60	3.70	5.65	3.48	2.08	1.90	1.45	1.30	1.65	2.00	2.90
28	7.65	7.15	3.62	5.58	3.38	1.98	1.82	1.32	1.38	1.62	2.00	3.02
29	7.20	......	3.62	5.45	3.28	1.88	1.72	1.30	1.45	1.55	2.00	3.10
30	6.75	......	3.70	5.30	3.18	1.78	1.58	1.25	1.50	1.50	2.00	3.25
31	6.48	......	3.78	......	3.10	......	1.50	1.22	......	1.45	......	3.40

NOTE.— Discharge affected by ice conditions and logs, January to March and December 13 to 31. Observer unable to read gage January 7–18 and February 21–25 on account of obstruction from ice and logs. Log jam also affected discharge from May 20 to about June 26.

Daily discharge, in second-feet, of Sacandaga River at Hadley, N. Y., for 1909.

DAY.	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	450	1,800	7,220	4,460	9,320	1,920	448	340	210	315	315	670
2	450	1,600	4,560	4,770	9,100	1,880	400	315	195	290	315	670
3	450	1,500	3,480	5,090	8,470	1,710	448	290	195	270	290	630
4	450	1,400	3,490	5,350	8,470	1,570	460	290	180	270	290	534
5	600	1,300	1,800	6,110	8,050	1,570	430	270	180	250	270	520
6	4,000	1,200	1,660	7,240	8,050	1,660	400	250	180	250	258	520
7	4,500	1,200	1,660	8,890	7,680	1,740	370	230	180	230	250	490
8	3,250	3,350	1,670	10,600	7,640	1,780	340	210	195	230	290	460
9	2,500	2,950	1,660	12,500	7,280	1,880	340	210	195	210	290	430
10	2,000	2,500	1,580	13,600	6.930	1.920	315	195	210	210	290	430
11	1,750	3,000	1,500	12,700	7,240	3,060	290	180	210	210	315	400
12	1,600	2,850	1,440	13,800	7,840	2,160	270	180	210	230	315	400
13	1,400	2,950	2,500	15,400	9,750	2,340	270	180	210	230	315	420
14	1,250	2,250	1,300	16,800	9,100	2,230	270	165	230	230	290	420
15	1,130	2,600	1,270	18,300	8,260	2,080	290	165	230	250	290	420
16	1,050	2,500	1,170	19,200	7,640	1,780	290	195	230	250	290	420
17	980	2,350	1,100	19,700	7,280	1,740	315	315	230	258	290	420
18	930	2,200	1,020	18,000	7,160	1,830	315	815	230	270	315	420
19	910	2,200	984	17,100	6,290	1,960	340	990	210	290	340	420
20	900	6,000	932	16,400	5,940	2,120	340	815	195	290	388	420
21	900	9,000	983	15,600	5,260	2,460	330	630	180	315	400	420
22	900	7,600	1,000	15,000	4,460	1,710	315	576	165	340	430	420
23	900	6,000	1,220	13,600	3,930	1,340	340	520	180	388	460	420
24	900	5,000	1,540	12,700	3,870	1,090	388	472	210	490	490	420
25	2,160	10,000	2,330	12,200	3,590	966	490	448	230	490	534	420
26	2,930	8,000	3,380	11,900	3,370	815	570	388	230	460	606	420
27	3,000	7,000	3,380	11,300	3,010	742	590	315	250	430	670	420
28	2,800	6,740	3,220	11,000	2,760	654	534	258	282	412	670	420
29	2,600	......	3,300	10,400	2,520	576	472	250	315	370	670	420
30	2,300	......	3,580	9,750	2,300	508	388	230	340	340	670	420
31	2,000	......	3,870	......	2,120	......	340	218	......	315	......	420

NOTE.— Daily discharge during the periods which are not affected by ice or logs, based on a somewhat poorly defined rating curve. During the remainder of the year the discharge was estimated on the basis of measurements made during ice and log conditions and on intercomparison with other stations of the Hudson river drainage.

Monthly discharge of Sacandaga River at Hadley, N. Y., for 1907, '08, '09.
[Drainage area, 1,050 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
September 13–30	1,660	400	736	0.701	0.47	C
October	6,290	760	2,260	2.15	2.48	C
November	11,100	1,120	4,160	3.96	4.42	B
December	7,240	760	3,040	2.90	3.34	C
1908.						
January	6,110	670	(1,900)	1.81	2.09	C
February	*a*25,000	......	(3,420)	3.26	3.52	C
March	13,600	870	(3,480)	3.31	3.82	C
April	15,000	5,940	10,200	9.71	10.83	C
May	14,500	......	7,440	7.09	8.17	C
June	......	388	1,300	1.24	1.38	C
July	640	272	382	.364	.42	C
August	308	182	233	.222	.26	C
September	272	115	138	.131	.15	C
October	1,090	182	367	.350	.40	B
November	850	345	521	.496	.55	C
December	921	442	(637)	.607	.70	C
The year	25,000	115	2,500	2.38	32.29	
1909.						
January	4,500	450	(1,680)	1.60	1.84	C
February	10,000	1,200	(3,820)	3.64	3.79	C
March	7,220	932	(2,250)	2.14	2.47	C
April	19,700	4,460	12,300	11.7	13.05	C
May	9,750	2,120	6,280	5.98	6.89	C
June	3,060	508	1,660	1.58	1.76	C
July	590	270	378	.360	.42	C
August	990	165	352	.335	.39	C
September	340	165	216	.206	.23	C
October	490	210	303	.289	.33	C
November	670	250	387	.369	.41	C
December	680	400	(456)	.434	.50	C
The year	19,700	165	2,510	2.39	32.08	

Note.—(*a*) Estimated. Monthly estimates for 1907–08 have been revised on the basis of additional data and differ slightly from those published in the fourth annual report of the State Water Supply Commission of New York.

Sacandaga River, Union Bag and Paper Company's mill, Hadley, N. Y.

This station is located on the steel highway bridge near the Union Bag and Paper Company's mills at Hadley, N. Y. It was established in cooperation with the U. S. Geological Survey, September 24, 1909, to obtain general statistical and comparative data in regard to the flow of the Sacandaga and to eliminate discrepancies due to log jams occurring at the Hadley station.

No tributaries of any importance enter the river between this station and the one on the second highway bridge near Hadley, N. Y. Gage heights are furnished twice daily through the courtesy of the Union Bag and Paper company. There are times in the year when the gage heights are affected by back water from the Hudson. Conditions for making discharge measurements are good and such measurements have been used in connection with those taken at the Hadley station to develop a fairly good rating curve.

Daily gage height, in feet, of Sacandaga River at Union Bag and Paper Company, near Hadley, N. Y., for 1909.

[Union Bag and Paper Company, observer.]

DAY.	Oct.	Nov.	Dec.	DAY.	Sept.	Oct.	Nov.	Dec.
1	4.50	4.38	5.20	17	......	4.15	4.42	4.90
2	4.30	4.38	5.10	18	......	4.18	4.45	5.05
3	4.35	4.52	5.25	19	......	4.30	4.65	5.05
4	4.35	4.38	5.18	20	......	4.40	4.48	5.25
5	4.25	4.38	4.98	21	......	4.40	4.42	5.50
6	4.20	4.40	4.92	22	......	4.50	4.48	5.50
7	4.08	......	4.78	23	......	4.60	4.48	5.50
8	4.05	4.40	4.80	24	4.00	4.80	4.68	5.40
9	4.05	4.30	4.80	25	4.02	4.80	5.05	....
10	4.10	4.40	4.90	26	4.0	4.80	5.20	....
11	4.05	4.40	4.80	27	4.05	4.82	5.30	5.40
12	3.98	4.38	5.10	28	4.10	4.72	5.15	5.50
13	3.90	4.38	5.00	29	4.50	4.70	5.20	5.40
14	3.92	......	5.25	30	4.40	4.52	5.40	5.38
15	4.05	4.42	5.10	31	......	4.50	......	5.40
16	4.10	4.38	5.02					

GENESEE RIVER DRAINAGE BASIN.

Description.

Genesee river rises in Potter county, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles by general course, then turns to the northeast, and empties into Lake Ontario, 7 miles north of Rochester. The entire length of the stream, following bends, is about 135 miles, and the drainage area is about 2,450 square miles.

In the 39 miles between Belmont, in central Allegheny county, and Portage, in southwestern Livingston county, the fall of the water-surface is 253 feet, an average of 6.4 feet per mile. At Portage the river plunges down in three magnificent falls, and thence nearly to Mount Morris flows at the bottom of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows subject to occasional overflow. At Rochester there is another abrupt descent over three heavy falls, amounting to about 260 feet within the city.

In the northern counties the surface is rolling, with long, easy slopes, except along the streams, which usually lie in deep ravines, hemmed in by steep banks. On the whole there is a gradual rise away from the lakes, and in the upper half of the basin the country becomes rough and is broken by ridges, the summits of which attain elevations of from 2,000 to 2,500 feet above tide.

Precipitation is rather high, the average rainfall being about 35 inches, some 14 inches smaller than that of the upper Sacandaga. Possibilities for storage are great and the State Water Supply Commission of New York propose a high concrete dam, in the vicinity of Portage, which will store about 18 billion cubic feet of water, 11 billion cubic feet of which will be available for commercial purposes. This dam would have a water surface of about 13½ square miles. Such a reservoir would control a flow equal to the greatest recorded, that of 1865. In addition to this high degree of river control the reservoir could be used to develop electric horse-power at Portage to the extent of 75,000 horse-power, peak load, and at the same time allow the mills at Rochester to run the entire year.

Genesee River at St. Helena, N. Y.

This station is located on the steel highway bridge, about 6 miles by river below Genesee lower falls, 4 miles from Castile, and 5½ miles from Portageville. It was established August 14, 1908, in co-operation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the Genesee, which has important storage and power possibilities.

The bed is of coarse gravel with few rocks and is fairly permanent.

The datum of the gage has remained the same during the maintenance of the station. Conditions for obtaining accurate discharge measurements are excellent and a good rating table has been obtained.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Genesee River at St. Helena, N. Y., in **1909.**

DATE.	Hydrographer.	Width.	Area. of section.	Gage height.	Discharge.
		Feet.	*Sq. Ft.*	*Feet.*	*Sec.-ft.*
Jan. 25....	C. R. Adams	......	1,070	5.28	(*a*) 3,900
Feb. 16....	C. R. Adams	175	495	3.98	(*b*) 1,660
April 22....	C. C. Covert	299	587	3.74	1,370
May 1....	E. F. Weeks	329	2,410	9.75	22,300
May 2....	E. F. Weeks	315	2,000	8.40	14,800
May 2....	E. F. Weeks	309	1,800	7.72	11,900
May 3....	E. F. Weeks	305	1,360	6.35	7,160
May 3....	E. F. Weeks	302	1,260	5.96	5.800
May 4....	E. F. Weeks	306	1,120	5.60	4,780
May 4....	E. F. Weeks	311	1,090	5.42	4,520
May 5....	E. F. Weeks	310	975	5.02	3,940
Aug. 13....	C. C. Covert	107	93	1.60	(*c*) 72
Aug. 14....	C. C. Covert	104	83	1.52	(*c*) 57
Dec. 10....	C. C. Covert	103	221	2.35	(*d*) 182

(*a*) No ice at station, very little above or below.

(*b*) Anchor ice running in large quantities, and clogging meter. Discharge not much obstructed.

(*c*) Measurement made at wading section.

(*d*) Partial ice conditions, broken ice .05 foot thick.

Daily gage heights of Genesee River at St. Helena, N. Y., for 1909.
[Herman Piper, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	2.70	4.35	4.70	9.25	2.32	2.22	1.78	1.65	1.82	2.08	2.12
2	2.38	2.80	3.85	4.60	8.20	2.55	2.12	1.58	1.68	1.88	2.02	2.02
3	2.38	2.88	4.65	4.35	6.25	2.52	2.12	1.65	1.72	1.65	2.08	2.05
4	2.45	2.75	4.15	4.30	5.52	2.55	2.10	1.65	1.68	1.68	1.98	2.00
5	4.45	3.05	3.65	4.50	4.98	2.90	2.08	1.72	1.65	1.75	2.18	1.95
6	6.40	6.60	3.65	5.05	4.50	4.15	2.05	1.80	1.55	1.55	2.22	1.98
7	4.20	5.05	3.95	4.55	4.20	3.40	1.98	1.65	1.68	1.62	2.18	1.98
8	3.15	4.10	3.80	4.80	3.95	3.00	2.00	1.65	1.58	1.72	2.22	2.02
9	3.05	3.45	3.80	4.25	3.75	2.78	1.98	1.62	1.62	1.78	2.12	1.65
10	3.15	3.45	6.55	4.15	3.82	3.40	1.92	1.95	1.62	1.62	2.05	2.05
11	3.10	3.20	5.45	3.95	4.50	5.30	2.02	1.60	1.58	1.60	2.10	2.05
12	2.95	2.95	4.40	4.10	3.95	4.00	2.22	1.58	1.62	1.82	2.05	2.18
13	2.80	3.22	4.60	4.10	3.58	3.48	2.08	1.55	1.58	1.80	1.98	2.15
14	2.85	3.15	4.25	7.35	3.35	3.32	1.98	1.55	1.62	1.88	2.00	2.35
15	3.00	4.60	4.00	5.80	3.45	3.22	1.90	1.52	1.58	1.98	2.01	2.32
16	3.05	4.00	3.85	4.95	4.35	3.05	1.92	1.75	1.65	2.02	2.02	2.35
17	2.95	3.60	3.45	4.50	3.72	2.85	1.98	1.78	1.68	1.75	1.92	2.22
18	2.85	3.50	3.25	4.15	3.45	2.82	1.82	1.72	1.65	1.98	1.92	2.25
19	2.75	3.30	3.45	3.85	3.30	2.85	2.00	1.68	1.62	1.85	1.92	2.30
20	2.75	6.10	3.50	3.65	3.17	2.65	1.88	1.75	1.65	1.92	2.02	2.08
21	2.80	5.35	3.25	3.85	3.08	2.48	1.88	1.72	1.62	1.88	2.02	2.10
22	2.95	4.80	3.22	3.75	3.02	2.52	1.88	1.58	1.65	2.02	2.55	2.25
23	4.65	5.60	3.05	3.50	2.92	2.72	1.98	1.65	1.58	2.12	2.50	2.15
24	6.40	7.40	3.00	3.45	2.85	2.75	2.02	1.58	1.82	2.40	2.68	2.18
25	5.60	6.10	5.15	3.15	2.82	2.62	2.12	1.52	1.75	2.38	2.48	2.05
26	4.40	5.20	4.45	3.25	2.65	2.48	2.02	1.55	2.02	2.35	2.32	2.12
27	3.80	4.78	4.10	3.30	2.70	2.32	1.98	1.70	2.02	2.32	2.22	2.18
28	3.35	4.35	4.35	3.85	2.55	2.32	1.82	1.65	1.92	2.38	2.05	2.15
29	3.08	......	4.48	3.80	3.35	2.25	1.95	1.78	1.78	2.28	2.18	2.22
30	3.10	......	4.25	9.00	3.02	2.28	1.78	1.75	1.85	2.18	2.12	2.25
31	2.88	......	4.05	......	2.85	......	1.78	1.68	......	2.02	......	2.05

NOTE.— Ice conditions prevailed December 10–31. The remainder of the year was probably open.

Daily discharge of Genesee River at St. Helena, N. Y., for 1909.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	325	448	2,300	2,930	19,400	270	233	104	80	113	185	198
2	295	506	1,510	2,740	13,900	371	198	68	85	127	166	166
3	295	556	2,840	2,300	6,680	357	198	80	92	80	185	176
4	325	477	1,960	2,210	4,750	371	191	80	85	85	154	160
5	2,470	672	1,250	2,560	3,520	568	185	92	80	98	219	146
6	7,120	7,720	1,250	3,670	2,560	1,960	176	108	64	64	233	154
7	2,040	3,670	1,660	2,650	2,040	970	154	80	85	74	219	154
8	750	1,880	1,440	3,130	1,660	635	160	80	68	92	233	166
9	672	1,020	1,440	2,120	1,380	494	154	74	74	104	198	80
10	750	1,020	7,570	1,960	1,470	970	138	146	74	74	176	180
11	710	790	4,580	1,660	2,560	4,230	166	71	68	71	191	180
12	602	602	2,380	1,880	1,660	1,730	233	68	74	113	176	180
13	506	807	2,740	1,880	1,170	1,050	185	64	68	108	154	180
14	537	750	2,120	10,200	922	894	154	64	74	127	160	180
15	635	2,740	1,730	5,450	1,020	807	132	59	68	154	163	180
16	672	1,730	1,510	3,450	2,300	672	138	98	80	166	166	180
17	602	1,190	1,020	2,560	1,340	537	154	104	85	98	138	180
18	537	1,080	832	1,960	1,020	518	113	92	80	154	138	180
19	477	875	1,020	1,510	875	537	160	85	74	120	138	180
20	477	6,200	1,080	1,250	766	422	127	98	80	138	166	180
21	506	4,340	832	1,510	695	338	127	92	74	127	166	180
22	602	3,130	807	1,380	650	357	127	68	80	166	371	180
23	2,840	4,940	672	1,080	581	460	154	80	68	198	347	80
24	7,120	10,400	635	1,020	537	477	166	68	113	303	437	180
25	4,940	6,260	3,890	750	518	406	198	59	98	295	338	180
26	2,380	4,000	2,470	832	422	338	166	64	166	262	270	180
27	1,440	3,090	1,880	875	448	270	154	88	166	270	233	180
28	922	2,300	2,300	1,510	371	270	113	80	138	295	176	180
29	695	......	2,520	1,440	922	244	146	104	104	255	219	180
30	710	......	2,120	18,000	650	255	104	98	120	219	198	180
31	556	......	1,800	......	537	......	104	85	......	166	......	180

NOTE.— Daily discharge 1909 based on a well defined rating.

Daily discharge December 10–31, 1909, based on an ice measurement made December 10, 1909. This period is only approximate.

Monthly discharge of Genesee River at St. Helena, N. Y., for 1908, '09.
[Drainage area 1,030 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1908.						
August 14–31	672	160	294	.285	.19	A
September	160	80	121	.117	.13	A
October	160	108	125	.121	.14	A
November	244	80	168	.163	.18	A
December	......	......	160	.155	.18	C
1909.						
January	7,120	295	1,400	1.36	1.57	A
February	10,400	448	2,620	2.54	2.64	A
March	7,570	635	2,010	1.95	2.25	A
April	18,000	750	2,880	2.80	3.12	A
May	19,400	371	2,490	2.42	2.79	A
June	4,230	244	726	.705	.79	A
July	233	104	158	.153	.18	A
August	146	59	83.9	.082	.09	A
September	166	64	88.8	.086	.10	A
October	303	64	153	.149	.17	A
November	437	138	210	.204	.23	A
December	......	80	(173)	.168	.19	D
The year	19,400	59	1,080	1.05	14.12	

NOTE.— The above monthly discharge for 1908 supersedes the estimates given in the fourth annual report of the State Water Supply Commission. It is based on new data recently available. The monthly discharge for December, 1908, is based on the discharge at Mt. Morris, N. Y.

Genesee River at Mt. Morris, N. Y.

This station is at the dam of the Mt. Morris Power Company, of Mt. Morris N. Y., a short distance above the inflow of Canaseraga creek. It was established September 1, 1905, and was discontinued September 30, 1909.

The discharge is divided into two parts, that which runs over the dam and wasteways, and that which is used at the mills.

The dam is of stone masonry constructed with a horizontal crest and ogee cross section. It has a clear length of about 255 feet.

Several mills and factories use a portion of the flow, which is diverted through a head race composed of a section of the old Genesee Valley canal. The amount of this division has been determined by discharge measurements made by wading in the tail race.

During medium and low water conditions the water used by the wheels can be fairly well estimated from gage readings in the tail race, but at high water there is back water effect from Canaseraga creek.

The combined results of discharge over the dam and through the wheels at this station are very good at medium and high stages and at very low stages when all the water is used by the wheels. At the ordinary summer stages results are uncertain owing to the effect of pondage by the dam.

Information in regard to this station is contained in the annual reports of the U. S. Geological Survey and State Engineer's report, State of New York.

Discharge measurements of Genesee (Tail Race) at Mt. Morris, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 21	C. C. Covert	29	76	2.25	199
May 6	E. F. Weeks	29	72	2.00	181
Aug. 14	C. C. Covert	19	25	.60	(*a*)38
Aug. 15	C. C. Covert	28	54	1.38	106
Aug. 16	C. C. Covert	28	58	1.60	114

(*a*) Measurement made at wading section below bridge.

Daily discharge of Genesee River at Mt. Morris, N. Y., for 1909.

DAY.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.
1	368	584	1,740	2,660	18,800	612	250	118
2	271	640	1,650	3,190	15,100	479	224	172
3	346	674	2,600	2,400	6,930	479	212	172
4	422	767	2,230	2,120	4,770	467	197	340
5	1,950	909	1,520	2,480	3,640	562	262	191
6	6,500	5,370	1,360	3,400	2,670	2,000	201	178
7	2,510	4,220	1,480	4,750	2,130	1,160	196	166
8	1,000	1,680	1,590	3,210	1,710	849	195	82
9	836	1,460	1,650	2,140	1,470	659	206	152
10	853	1,370	7,680	1,980	1,580	647	213	142
11	923	1,040	5,810	1,620	2,570	4,430	165	142
12	844	794	2,790	1,780	1,880	2,000	224	142
13	501	1,110	2,590	1,970	1,430	1,210	201	142
14	541	869	2,120	10,100	1,210	946	166	122
15	758	1,560	1,710	5,640	1,200	1,210	178	82
16	724	1,560	1,580	3,630	2,040	843	184	154
17	559	1,420	1,260	4,730	1,630	777	190	148
18	657	1,130	1,110	2,030	1,260	594	105	160
19	642	1,180	1,160	1,710	1,150	659	190	148
20	609	4,390	1,150	1,480	960	536	184	154
21	705	4,900	918	1,360	913	443	184	136
22	659	3,300	946	1,490	823	455	197	82
23	4,700	5,430	889	1,550	777	419	190	148
24	7,740	13,400	903	1,200	752	600	190	136
25	4,880	10,800	1,820	1,050	640	428	87	142
26	2,290	4,300	6,760	946	602	377	204	154
27	1,650	3,130	1,880	966	546	337	190	154
28	1,210	2,300	2,290	1,270	519	288	190	154
29	767	......	2,310	1,590	1,130	268	184	82
30	650	......	2,060	13,700	853	212	184	154
31	672	......	1,730	......	764	......	172	154

NOTE.— Forty second-feet added for leakage through canal and waste weir January to May. Flash boards on waste weir June to September cut leakage down to about 6 second-feet.

Monthly discharge of Genesee River at Mt. Morris, N. Y., for 1909.

[Drainage area, 1,070 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	7,740	346	1,540	1.44	1.66	B
February	13,400	584	2,870	2.68	2.79	B
March	7,680	889	2,170	2.03	2.34	B
April	13,700	946	2,940	2.75	3.07	B
May	18,800	519	2,660	2.49	2.87	B
June	4,430	212	832	.778	.87	B
July	262	87	191	.179	.21	C
August	340	82	148	.138	.16	D

Genesee River at Jones' Bridge, near Mt. Morris, N. Y.

This station is at the highway bridge known as Jones' bridge, a short distance below the inflow of Canaseraga creek, and is about 5 miles below Mt. Morris. This station was established May 22, 1903, and was discontinued April 30, 1906. It was re-established August 12, 1908, in co-operation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the flow of the Genesee.

The bed of the stream is of clay, and probably subject to change at times. There is one channel at low stages, two at high. The current is good at medium and high stages, but poor during low water conditions.

Discharge measurements are made from a foot bridge erected on the outriggers of the downstream side of the bridge.

The datum of the gage has remained permanent during the maintenance of the station. Conditions for making discharge measurements are favorable and a fairly good rating table has been developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Genesee River at Jones' Bridge, near Mt. Morris, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 6....	C. R. Adams....................	145	799	9.03	3,080
Feb. 17....	C. R. Adams....................	160	1,210	11.77	(*a*)1,280
April 21....	C. C. Covert....................	128	509	6.95	1,840
Aug. 14....	C. C. Covert....................	48	48	3.25	(*b*)114
Aug. 15....	C. C. Covert....................	39	35	3.10	(*b*)64
Dec. 9....	C. C. Covert....................	65	164	3.58	(*c*)161

(*a*) Floating anchor ice clogged in large quantities below the bridge, causing backwater. Measurement largely estimated.

(*b*) Measurement made at wading section.

(*c*) Some shore ice: measurement not materially affected thereby.

Daily gage height of Genesee River at Jones' Bridge, near Mt. Morris, N. Y., for **1909.**
[Elizabeth Trewer, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.50	7.10	8.15	9.25	25.85	4.95	4.17	3.01	3.45	3.45	3.80	4.00
2	4.45	7.00	7.70	9.80	23.25	4.90	4.07	3.51	3.40	3.60	3.80	4.00
3	4.35	7.40	9.25	9.80	23.20	4.80	4.07	3.51	3.40	3.35	3.80	3.90
4	4.35	7.65	8.85	8.60	17.95	4.70	3.92	3.36	3.40	3.55	3.70	3.90
5	5.85	7.90	7.30	8.85	12.95	5.15	3.87	3.25	3.40	3.50	3.80	3.75
6	13.50	15.55	6.75	9.55	10.60	7.55	3.87	3.25	3.40	3.55	4.10	3.85
7	8.80	12.20	7.50	12.50	8.70	6.60	3.87	3.10	3.40	3.50	4.05	3.85
8	6.65	8.50	7.30	10.05	8.05	5.75	3.87	2.85	3.20	3.50	3.90	3.75
9	6.35	6.95	7.65	7.35	7.40	5.25	3.67	3.35	3.20	3.35	3.85	3.65
10	6.15	6.50	14.65	7.50	8.10	5.25	3.62	3.20	3.20	3.25	3.75	3.40
11	6.00	6.05	14.60	7.60	9.15	12.00	3.47	3.15	3.20	3.40	3.90	3.35
12	6.20	5.60	10.20	7.60	8.10	8.30	4.22	3.20	3.15	3.60	3.85	3.75
13	6.65	5.90	9.55	7.70	7.00	6.75	4.21	3.15	3.15	3.70	3.80	3.95
14	6.50	6.60	8.60	13.45	6.60	6.20	4.01	3.08	3.10	3.75	3.80	3.85
15	6.45	7.80	7.75	19.05	6.45	6.15	3.71	3.15	3.15	3.70	3.90	4.05
16	6.95	11.55	7.25	11.95	7.50	5.65	3.66	3.20	3.20	3.60	3.80	4.00
17	7.00	11.90	6.80	9.85	7.75	5.30	3.71	3.30	3.30	3.40	3.80	4.00
18	6.60	10.85	6.20	8.70	7.25	5.15	3.36	3.45	3.15	3.40	3.75	4.05
19	6.55	10.35	6.30	7.90	6.65	5.10	3.86	3.55	3.25	3.45	3.75	4.20
20	6.50	11.10	6.05	7.25	5.75	4.85	3.76	3.55	3.35	3.70	3.80	4.75
21	6.50	15.20	5.75	6.90	5.70	4.77	3.71	3.80	3.20	3.65	3.75	5.20
22	6.80	12.35	5.65	6.95	5.60	4.57	3.56	3.45	3.10	3.75	3.95	5.50
23	13.20	14.60	5.60	7.25	5.50	4.72	3.71	3.30	3.05	3.85	4.50	5.90
24	16.60	21.55	5.65	7.00	5.35	4.92	3.71	3.40	3.25	4.15	4.65	4.75
25	12.10	24.20	9.55	7.20	5.20	4.77	3.71	3.25	3.50	4.50	4.55	4.35
26	9.25	17.55	10.05	7.25	5.15	4.57	3.91	3.10	3.40	4.35	4.25	4.40
27	7.50	12.25	8.55	7.05	5.05	4.42	3.91	3.25	3.85	4.30	4.10	4.40
28	6.45	10.20	8.90	6.90	5.00	4.37	3.76	3.40	3.80	4.20	4.10	4.45
29	5.80	......	8.85	7.50	6.10	4.37	3.81	3.05	3.75	4.15	4.05	4.40
30	5.75	......	8.35	17.25	5.80	4.27	3.71	3.40	3.60	4.05	4.00	4.50
31	6.50	......	7.85	......	5.20	......	3.56	3.33	......	3.85	......	4.45

NOTE.— Back water at the gage due to ice conditions February 1–4, 16–19, and December 18–31; also probably slight affect from ice for brief periods at other times, January to March and December.

Daily discharge of Genesee River at Jones' Bridge, near Mt. Morris, N. Y., for 1909

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	490	1,100	2,500	3,220	16,200	688	360	46	138	138	235	300
2	470	800	2,210	3,610	16,600	665	324	152	125	175	235	300
3	430	800	3,220	3,610	14,100	620	324	152	125	112	235	265
4	430	800	2,950	2,790	9,920	575	272	115	125	162	205	265
5	1,150	2,340	1,970	2,950	5,920	785	256	90	125	150	235	220
6	6,360	8,000	1,640	3,440	4,170	2,120	256	90	125	162	335	250
7	2,920	5,320	2,090	5,560	2,860	1,560	256	60	125	150	318	250
8	1,590	2,720	1,970	3,780	2,430	1,090	256	30	80	150	265	220
9	1,420	1,760	2,180	2,000	2,030	835	196	112	80	112	250	190
10	1,310	1,500	7,280	2,090	2,460	835	181	80	80	90	220	125
11	1,230	1,260	7,240	2,150	3,160	5,170	142	70	80	125	265	112
12	1,340	1,010	3,890	2,150	2,460	2,600	378	80	70	175	250	220
13	1,590	1,180	3,440	2,210	1,790	1,640	374	70	70	205	235	282
14	1,500	1,560	2,790	6,320	1,560	1,340	304	57	60	220	235	250
15	1,480	2,270	2,240	10,800	1,480	1,310	208	70	70	205	235	318
16	1,760	4,000	1,940	5,130	2,090	1,040	193	80	80	175	235	300
17	1,790	1,280	1,670	3,640	2,240	860	208	100	100	125	235	300
18	1,560	1,200	1,340	2,860	1,940	785	115	138	70	125	220	280
19	1,530	1,200	1,400	2,340	1,590	760	253	162	90	138	220	280
20	1,500	4,520	1,260	1,940	1,090	642	223	162	112	205	235	280
21	1,500	7,720	1,090	1,730	1,060	606	208	235	80	190	220	280
22	1,670	5,440	1,040	1,760	1,010	518	165	138	60	220	282	280
23	6,120	7,240	1,010	1,940	960	584	208	100	52	250	490	280
24	8,840	12,800	1,040	1,790	885	674	208	125	90	352	552	280
25	5,240	14,900	3,440	1,910	810	606	208	90	150	490	510	280
26	3,220	9,600	3,780	1,940	785	518	268	60	125	430	390	280
27	2,090	5,360	2,760	1,820	735	458	268	90	250	410	335	280
28	1,480	3,890	2,980	1,730	710	438	223	125	235	370	335	280
29	1,120	......	2,950	2,090	1,280	438	238	52	220	352	318	280
30	1,090	......	2,630	9,360	1,120	398	208	125	175	318	300	280
31	1,500	......	2,300	......	810	......	165	108	......	250	......	280

NOTE.— Daily discharge for open channel periods based on a well defined rating. Discharge during the periods of ice conditions based on measurements made under ice cover and the discharge at other Genesee river stations.

Monthly discharge of Genesee River at Jones' Bridge, near Mt. Morris, N. Y., for **1908–'09.**

[Drainage area, 1,410 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square. mile.		
1908.						
August 11-31	1,010	220	467	0.331	0.26	A
September	250	52	171	.121	.14	A
October	190	40	151	.107	.12	A
November	352	60	216	.153	.17	A
December	......	......	(230)	.163	.19	B
1909.						
January	8,840	430	(2,120)	1.50	1.73	C
February	14,900	800	(3,980)	2.82	2.94	C
March	7,280	1,010	2,590	1.84	2.12	B
April	10,800	1,730	3,290	2.33	2.60	A
May	16,600	710	3,430	2.43	2.80	A
June	5,170	398	1,040	.738	.82	A
July	378	115	240	.170	.20	A
August	235	30	102	.072	.08	A
September	250	52	112	.079	.09	A
October	490	90	217	.154	.18	A
November	552	205	288	.204	.23	A
December	318	112	(261)	.185	.21	C
The year	16,600	30	1,470	1.04	14.00	

RAQUETTE RIVER DRAINAGE BASIN.

Description.

Raquette river rises in northern Hamilton county, flows practically north through a long narrow valley to St. Lawrence river. It has a total length of 162 miles, from its source to its confluence with the St. Lawrence, near the most northern point of the state.

Its source is on an elevated plateau of some 1,600 feet above sea level. The upper water-shed includes many acres of swamp land, as well as a large area of lakes and ponds, including Tupper lake, Little Tupper lake, Long lake, Round lake, Blue Mountain lake, Forked lake and Raquette lake.

The high region is most prolific in rain-fall, the mean annual amounting to about 48 inches, or about 10 inches above the mean for the state.

In its course through the mountains the river exhibits many falls and rapids, inviting power development under private enterprise. As yet, however, only 400 feet of the 1,400 feet of fall in the river, below Tupper lake, has been developed. The river has tremendous fluctuations between the maximum and mimimum flow and is in great need of artificial regulation if the best possibilities of power development are to be realized. The State Water Supply Commission of New York have under consideration extensive storage developments on this stream which, when completed, will materially benefit the existing powers and tend to make the undeveloped portions of greater economic importance.

Raquette River at Raquette Falls, near Coreys, N. Y.

This station is near the centre of Raquette falls about 8 miles, by river, upstream from the village of Axton, which is 12 miles, by road, from the village of Tupper Lake. The station was established August 27, 1908, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of Raquette river.

The river has one channel for all stages. The current is favorable for making discharge measurements. The bed of the river is rocky, composed of large boulders, and is permanent. During low water the current is sluggish. At high and medium stages the current is suitable for good discharge measurements.

Measurements are made from a car hung from a cable which was erected during the summer of 1909. Previous to that time measurements were made by wading about 2,000 feet down stream.

A gage reader is only obtainable during the summer, therefore no winter records are available.

The datum of the gage has remained the same during the maintenance of the station. The low water portion of the curve is well defined. No measurements have, as yet, been made to determine the high water discharge.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Raquette River at Raquette Falls, near Coreys, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 10	Covert and Hoyt	93	185	1.91	(*a*)258
July 14	W. G. Hoyt	90	175	1.79	(*a*)267
Oct. 3	W. G. Hoyt	83	243	1.81	(*b*)260
Nov. 7	Hoyt and Covert	69	194	1.50	(*b*)153

(*a*) Made by wading at foot of falls.
(*b*) Made from cable at regular section.

Daily gage height, in feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1909.

[C. A. DeLancett, observer.]

DAY.	July.	Aug.	Sept.	Oct.	DAY.	July.	Aug.	Sept.	Oct.
1	......	1.7	1.5	1.65	17	1.7	1.45	1.3	1.3
2	......	1.65	1.6	1.65	18	1.8	1.65	1.3	1.3
3	......	1.6	1.5	1.8	19	1.9	1.80	1.3	1.3
4	......	1.55	1.4	1.8	20	1.95	1.85	1.25	1.2
5	......	1.5	1.45	1.8	21	1.9	1.8	1.15	1.25
6	......	1.5	1.6	1.7	22	1.8	1.7	1.15	1.35
7	......	1.45	1.5	1.6	23	1.8	1.6	1.15	1.5
8	......	1.4	1.4	1.5	24	1.8	1.5	1.6	1.6
9	......	1.4	1.35	1.45	25	2.0	1.4	1.4	1.5
10	......	1.35	1.3	1.45	26	2.0	1.4	1.3	1.45
11	1.95	1.3	1.3	1.4	27	1.9	1.4	1.3	1.45
12	1.9	1.3	1.3	1.35	28	1.8	1.4	1.4	1.45
13	1.9	1.25	1.3	1.35	29	1.8	1.4	1.5	1.4
14	1.8	1.25	1.25	1.35	30	1.7	1.4	1.65	1.4
15	1.7	1.2	1.3	1.35	31	1.75	1.45	......	1.4
16	1.7	1.35	1.3	1.3					

Daily discharge, in second-feet, of Raquette River at Raquette Falls, near Coreys, N. Y. for 1909.

DAY.	July.	Aug.	Sept.	Oct.	DAY.	July.	Aug.	Sept.	Oct.
1	......	217	159	202	17	217	147	115	115
2	......	202	187	202	18	250	202	115	115
3	......	187	159	250	19	285	250	115	115
4	......	173	135	250	20	304	268	106	97
5	......	159	147	250	21	285	250	89	106
6	......	159	187	217	22	250	217	89	125
7	......	147	159	187	23	250	187	89	159
8	......	135	135	159	24	250	159	187	187
9	......	135	125	147	25	323	135	135	159
10	......	125	115	147	26	323	135	115	147
11	304	115	115	135	27	285	135	115	147
12	285	115	115	125	28	250	135	135	147
13	285	106	115	125	29	250	135	159	135
14	250	106	106	125	30	217	135	202	135
15	217	97	115	125	31	234	147	......	135
16	217	125	115	115					

NOTE.— Daily discharge based on a fairly well-defined rating.

Monthly discharge of Raquette River at Raquette Falls, near Coreys, N. Y., for 1908–'09.
[Drainage area, 418 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1908.						
August 27–31	129	106	115	0.275	0.05	B
September	106	49	70.8	.169	.19	B
October	135	81	114	.273	.31	B
1909.						
July 11–31	323	217	263	.629	.49	B
August	268	97	159	.380	.44	B
September	202	89	132	.316	.35	B
October	250	97	154	.368	.42	B

NOTE.— Monthly discharge given above for 1908 supersedes those published in the fourth annual report.

Raquette River at Piercefield, N. Y.

This station is located at the head of Black rapids, about ¼ mile downstream from the dam of the International Paper Company in the town of Piercefield. It was established August 20, 1908, in co-operation with the U. S. Geological Survey to obtain general and statistical data regarding the flow of the Raquette.

There is one channel at all stages. The current is good at medium and high water stages but becomes sluggish under low water conditions. Discharge measurements are made at low and medium stages by means of a boat fastened to a wire, stretched immediately above the head of the rapids. During high water, measurements are made from the highway bridge above the paper mills. Ice seldom forms at the boat section and in consequence the open water curve has been used throughout the entire year.

The datum of the gage has remained fairly permanent during the maintenance of the station. The rating table is fairly well defined.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Raquette River at Piercefield, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 5	C. R. Adams	107	1,460	2.75	752
Jan. 29	C. R. Adams	107	1,700	3.96	1,400
April 18	C. C. Covert	107	2,040	7.30	4,540
July 9	Covert and Hoyt	102	491	2.02	555
July 12	W. G. Hoyt	102	479	2.09	531
Oct. 4	Hoyt and Williams	96	461	2.32	579

Daily gage height, in feet, of Raquette River at Piercefield, N. Y., for 1909.
[W. B. Graves, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.65	3.75	3.70	3.10	7.30	6.10	2.90	1.70	1.00	1.60	1.00	2.00
2	2.75	4.00	4.10	3.25	7.10	6.10	2.90	1.70	1.20	1.60	1.00	1.75
3	2.25	3.65	4.10	3.55	7.10	5.65	2.90	1.70	1.20	1.60	1.00	1.75
4	2.10	3.65	4.10	1.00	7.10	5.50	2.85	1.70	1.10	1.60	1.20	1.50
3	2.65	4.00	4.00	3.60	7.10	5.15	2.90	1.70	1.00	1.60	1.30	1.50
6	2.70	4.00	4.00	3.50	7.10	5.65	2.50	1.70	1.05	1.80	1.30	2.00
7	2.20	3.20	4.10	3.25	7.15	5.45	2.15	1.60	1.05	1.80	1.00	2.00
8	2.45	3.75	4.20	4.40	7.10	5.15	2.10	1.50	1.10	1.80	1.30	1.90
9	2.85	3.50	4.30	5.00	7.50	5.15	2.10	1.50	1.00	1.75	1.30	2.00
10	1.10	4.10	3.90	4.70	7.50	5.20	2.00	1.50	1.15	1.80	1.30	2.00
11	2.10	4.00	4.00	4.90	7.70	4.85	2.05	1.50	1.45	1.80	1.30	2.00
12	2.85	4.05	4.15	5.20	7.70	4.80	2.00	1.50	1.75	1.80	1.30	1.00
13	2.40	4.50	3.90	5.10	8.05	4.65	2.10	1.40	2.50	1.75	1.30	2.05
14	2.50	2.50	2.40	6.40	8.10	4.40	2.10	1.40	2.55	1.65	.90	2.00
15	2.85	4.00	4.15	6.55	7.90	2.85	2.10	1.40	2.50	1.70	.55	2.00
16	3.00	3.85	4.00	6.90	7.85	2.85	2.00	1.40	2.35	1.70	1.20	2.00
17	1.40	3.90	4.00	7.30	7.90	2.85	2.00	1.25	2.20	1.20	1.20	1.85
18	2.40	4.15	3.90	7.40	7.90	2.90	1.95	1.10	1.90	1.60	1.20	1.80
19	2.40	3.30	3.95	7.70	7.90	2.85	1.85	1.10	1.50	1.70	1.20	1.20
20	2.50	4.95	3.65	7.90	7.50	2.55	1.85	1.10	1.70	1.70	1.20	1.80
21	2.50	2.50	1.85	7.90	7.45	2.90	1.80	1.10	1.85	1.70	1.00	1.70
22	2.40	2.15	3.50	7.90	7.00	3.10	1.80	1.10	1.85	1.70	1.00	1.80
23	2.85	4.00	3.70	8.05	6.90	3.15	1.80	1.15	1.80	1.20	1.05	1.80
24	1.00	4.15	3.55	8.00	7.05	3.20	1.80	1.25	1.70	1.00	1.05	1.70
25	2.40	4.00	3.60	8.00	7.35	3.15	1.80	1.25	1.55	1.20	1.80	1.70
26	2.50	4.10	3.30	7.80	7.00	3.15	1.70	1.15	1.20	1.20	2.05	1.00
27	2.50	4.00	3.05	7.90	6.85	3.10	1.70	.95	1.20	1.20	2.00	1.45
28	3.25	3.75	1.15	7.65	6.50	3.00	1.70	1.00	1.20	1.20	1.00	1.80
29	2.50	......	3.30	7.55	6.60	3.00	1.70	.95	1.40	1.20	1.75	1.80
30	4.00	......	3.50	7.45	6.70	2.95	1.70	.95	1.55	1.20	2.00	1.80
31	1.00	......	3.05	......	6.55	......	1.70	1.00	......	1.00	......	1.80

NOTE.— On account of the swiftness of the current, ice seldom forms at this station, to the extent of affecting the relation between gage height and discharge.

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for **1909.**

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	704	1,270	1,240	918	4,540	3,250	818	371	210	344	210	462
2	748	1,430	1,500	993	4,320	3,250	818	371	249	344	210	386
3	550	1,210	1,500	1,150	4,320	2,800	818	371	249	344	210	386
4	497	1,210	1,500	210	4,320	2,650	794	371	228	344	249	318
5	704	1,430	1,430	1,180	4,320	2,340	818	371	210	344	270	318
6	725	1,430	1,430	1,120	4,320	2,800	642	371	219	400	270	462
7	532	968	1,500	993	4,370	2,600	514	344	219	400	210	462
8	623	1,270	1,570	1,710	4,320	2,340	497	318	228	400	270	430
9	794	1,120	1,640	2,200	4,780	2,340	497	318	210	386	270	462
10	228	1,500	1,360	1,940	4,780	2,380	462	318	238	400	270	462
11	497	1,430	1,430	2,110	5,020	2,060	480	318	306	400	270	462
12	794	1,460	1,540	2,380	5,020	2,020	462	318	386	400	270	210
13	604	1,780	1,360	2,290	5,440	1,900	497	293	642	386	270	480
14	642	642	604	3,560	5,500	1,710	497	293	662	358	192	462
15	794	1,430	1,540	3,710	5,260	794	497	293	642	371	142	462
16	868	1,330	1,430	4,090	5,200	794	462	293	586	371	249	462
17	293	1,360	1,430	4,540	5,260	794	462	260	532	249	249	415
18	604	1,540	1,360	4,660	5,260	818	446	228	430	344	249	400
19	604	1,020	1,400	5,020	5,260	794	415	228	318	371	249	249
20	642	2,160	1,210	5,260	4,780	662	415	228	371	371	249	400
21	642	642	415	5,230	4,720	818	400	228	415	371	210	371
22	604	514	1,120	5,260	4,200	918	400	228	415	371	210	400
23	794	1,430	1,240	5,440	4,090	943	400	238	400	249	219	400
24	210	1,540	1,150	5,380	4,260	968	400	260	371	210	219	371
25	604	1,430	1,180	5,380	4,600	943	400	260	331	249	400	371
26	642	1,500	1,020	5,140	4,200	943	371	238	249	249	480	210
27	642	1,430	893	5,260	4,040	918	371	201	249	249	462	306
28	993	1,270	238	4,960	3,660	868	371	210	249	249	210	400
29	642	......	1,020	4,840	3,760	868	371	201	293	249	386	400
30	1,430	......	1,120	4,720	3,870	843	371	201	331	249	462	400
31	210	......	893	......	3,710	......	371	210	......	210	......	400

Monthly discharge of Raquette River at Piercefield, N. Y., for **1908–'09.**
[Drainage area, 723 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1908.						
August 20–31	642	462	554	0.766	0.34	A
September	456	90	220	.304	.34	A
October	101	91	95.9	.133	.15	A
November	224	98	133	.184	.21	A
December	868	210	387	.535	.62	A
1909.						
January	1,430	210	641	.887	1.02	A
February	2,160	514	1,310	1.81	1.88	A
March	1,640	238	1,230	1.70	1.96	A
April	5,440	210	3,390	4.69	5.23	A
May	5,500	3,660	4,560	6.31	7.28	A
June	3,250	662	1,600	2.21	2.47	A
July	818	371	501	.693	.80	A
August	371	201	282	.390	.45	A
September	662	210	348	.481	.54	A
October	400	210	330	.456	.53	A
November	480	142	270	.373	.42	A
December	480	210	393	.544	.63	A
The year	5,500	142	1,230	1.71	23.21	

Raquette River at Massena Springs, N. Y.

This station is at the highway bridge in the village of Massena Springs, N. Y. It was established September 21, 1903, and observations were continued until October 17, 1903, when the station was temporarily abandoned but was resumed April 9, 1904. It was established in co-operation with the U. S. Geological Survey to obtain general and statistical data regarding the flow of Raquette river.

The current is swift and uniform. The channel is fairly permanent and conditions are such as to warrant good discharge measurements. A very good rating table has been developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey and the State Engineer's report, State of New York.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 14	C. R. Adams	168	709	5.55	a1,660
April 19	C. C. Covert	176	1,640	9.19	8,300
July 3	C. C. Covert	169	426	2.50	961

a Measurement made under partial ice cover. Average thickness of ice 1.70 feet. Gage height to top of ice, 5.75. Ice varied in section from .00 feet to 3.00 feet thick.

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1909.
[Mrs. C. A. Waitt, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	5.6	7.2	7.4	9.5	6.35	2.8	1.5	1.45	1.75	1.85	3.15
2	2.9	5.3	7.0	7.4	10.3	6.3	2.4	1.8	2.15	2.10	1.80	2.95
3	3.2	5.6	7.0	7.7	9.8	5.75	2.65	1.8	1.85	1.75	1.75	2.85
4	2.6	5.5	6.8	7.8	8.2	5.65	1.95	1.7	1.95	2.20	1.65	2.65
5	3.1	5.3	6.8	9.2	7.7	5.2	2.95	1.65	2.05	2.15	1.75	2.30
6	4.8	9.15	6.7	9.4	7.2	5.5	2.95	1.8	1.75	2.40	1.75	2.20
7	4.8	9.1	6.5	9.0	7.5	5.45	2.8	1.85	1.80	2.20	1.65	2.45
8	4.6	7.0	6.4	7.9	7.7	5.35	2.15	1.75	1.85	2.15	1.75	2.55
9	4.6	6.2	6.4	7.5	7.5	5.1	2.3	1.7	1.75	2.10	1.75	2.75
10	4.0	6.1	6.4	6.6	7.6	4.95	2.2	1.7	1.85	2.15	2.05	2.95
11	4.4	6.1	6.3	7.0	10.9	4.85	1.7	2.15	1.85	2.00	2.15	2.95
12	4.4	6.1	6.3	7.8	10.6	4.65	1.6	1.95	1.6	1.90	2.05	3.40
13	4.4	6.1	6.3	8.0	8.9	4.55	2.25	1.9	1.6	1.95	1.75	3.40
14	4.6	5.9	6.3	8.0	8.7	4.55	2.35	1.85	1.75	1.85	1.60	3.50
15	4.5	6.0	6.1	8.9	8.2	4.5	2.3	1.65	1.9	1.95	1.65	3.25
16	4.5	6.0	6.1	8.9	8.6	4.2	2.4	1.65	1.8	2.05	1.85	3.15
17	3.7	6.0	5.4	9.0	8.7	3.85	2.25	1.65	1.95	1.90	2.10	3.10
18	3.9	5.8	5.4	9.0	8.5	3.6	2.05	1.75	2.05	1.85	1.95	2.65
19	3.9	5.7	5.5	9.2	8.2	2.75	2.1	1.65	2.00	1.90	1.80	2.50
20	3.5	5.6	5.5	9.1	8.4	2.75	2.05	1.9	1.9	1.85	1.80	2.40
21	3.5	7.7	5.3	9.1	8.0	3.05	2.5	1.85	1.95	1.95	2.20	2.35
22	4.3	7.5	5.2	9.0	7.9	3.05	2.45	1.65	1.9	2.15	1.70	2.35
23	4.5	7.3	5.2	9.0	7.9	3.0	2.35	1.8	1.8	1.90	1.80	2.25
24	5.0	7.3	5.4	8.9	7.7	3.1	2.35	1.85	1.9	1.45	2.65	2.25
25	5.2	10.5	5.4	8.7	7.35	2.95	2.0	1.70	1.8	2.15	2.85	2.35
26	5.5	8.2	6.2	8.7	7.0	2.8	1.6	1.75	1.75	2.05	3.15	2.05
27	5.6	7.5	6.3	8.5	6.95	2.95	2.05	1.60	1.85	2.05	3.25	2.40
28	5.4	7.3	7.0	8.4	6.95	3.0	2.25	1.60	1.75	2.15	2.75	2.05
29	5.5	......	7.0	8.5	6.95	2.8	2.1	1.40	1.8	1.90	2.25	2.35
30	5.5	......	7.2	8.8	6.8	3.0	2.15	1.60	1.75	1.75	2.40	2.55
31	5.6	......	7.2	......	6.55	......	2.2	1.45	......	1.65	......	2.80

NOTE.— Gage heights affected by backwater from ice conditions January 1 to about April 15 and from about November 24 to December 31.

Daily discharge, in second-feet, of Raquette River at Massena Springs, N. Y., for 1909.

DAY.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	......	8,800	4,430	1,120	365	345	475	525
2	......	10,100	4,360	845	500	690	660	500
3	......	9,280	3,760	1,020	500	525	475	475
4	......	6,880	3,660	578	450	578	720	428
5	......	6,180	3,200	1,230	428	632	690	475
6	......	5,490	3,500	1,230	500	475	845	475
7	......	5,900	3,450	1,120	525	500	720	428
8	......	6,180	3,350	690	475	525	690	475
9	......	5,900	3,100	780	450	475	660	475
10	......	6,040	2,950	720	450	525	690	632
11	......	11,000	2,850	450	690	525	605	690
12	......	10,600	2,660	405	578	405	550	632
13	......	7,900	2,580	750	550	405	578	475
14	......	7,600	2,580	812	525	475	525	405
15	......	6,880	2,530	780	428	550	578	428
16	7,900	7,450	2,260	845	428	500	632	525
17	8,050	7,600	1,950	750	428	578	550	660
18	8,050	7,300	1,740	632	475	632	525	578
19	8,350	6,880	1,080	660	428	605	550	500
20	8,200	7,160	1,080	632	550	550	525	500
21	8,200	6,600	1,310	910	525	578	578	720
22	8,050	6,460	1,310	878	428	550	690	450
23	8,050	6,460	1,270	812	500	500	550	500
24	7,900	6,180	1,340	812	525	550	345	550
25	7,600	5,690	1,230	605	450	500	690	550
26	7,600	5,230	1,120	405	475	475	632	550
27	7,300	5,160	1,230	632	405	525	632	550
28	7,160	5,160	1,270	750	405	475	690	550
29	7,300	5,160	1,120	660	325	500	550	550
30	7,750	4,970	1,270	690	405	475	475	550
31	......	4,670	......	720	345	......	428	....

NOTE.— Daily discharge based on a well-defined rating.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1907, '08, '09.
[Drainage area, 1,170 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	......	......	(3,000)	2.56	2.95	D
February	......	......	(650)	5.56	.58	D
March	......	......	(2,000)	1.71	1.97	D
April	9,920	1,820	3,790	3.24	3.62	A
May	6,320	2,710	4,210	3.60	4.15	A
June	2,800	1,050	1,770	1.51	1.68	A
July	2,170	845	1,430	1.22	1.41	A
August	1,050	405	616	.526	.61	A
September	980	365	606	.518	.58	A
October	2,710	550	1,850	1.58	1.82	A
November	3,500	2,000	2,540	2.17	2.42	A
December	......	......	(2,000)	1.71	1.97	D
The year	9,920	365	2,040	1.74	23.76	
1908.						
January	7,450	......	(3,000)	2.56	2.95	D
February	......	......	(2,000)	1.71	1.84	D
March	......	......	(4,000)	3.42	3.94	D
April	......	3,600	(5,360)	4.58	5.11	A
May	8,500	4,490	6,670	5.70	6.57	A
June	4,490	780	1,990	1.70	1.90	A
July	2,080	365	902	.771	.89	A
August	980	325	545	.466	.54	A
September	720	105	343	.293	.33	B
October	365	155	260	.222	.26	B
November	1,050	130	434	.371	.41	B
December	......	......	(673)	.575	.66	D
The year	8,500	105	2,180	1.86	25.40	
1909.						
January	......	......	(850)	.726	.84	C
February	......	......	(1,800)	1.54	1.60	C
March	......	......	(1,700)	1.45	1.67	C
April	8,350	......	(5,170)	4.42	4,93	B
May	11,000	4,670	6,870	5.87	6.77	A
June	4,430	1,080	2,320	1.98	2.21	A
July	1,230	405	772	.660	.76	A
August	690	325	468	.400	.46	B
September	690	345	521	.445	.50	A
October	845	345	597	.510	.59	A
November	720	405	527	.450	.50	A
December	......	......	550	.470	.54	C
The period	11,000	325	1,850	1.58	21.37	

NOTE.— Monthly estimates for 1907–'08 have been revised on the basis of additional data. They differ slightly from those published in the fourth annual report of the State Water Supply Commission.

Bog River near Tupper Lake, N. Y.

This station is about 2½ miles above Tupper Lake and Bog River falls, and about 300 feet below the forks of Tupper Lake stream and Bog river in the town of Piercefield. The station was established August 24, 1908, in co-operation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the flow of Bog river.

The datum of the gage has remained the same during the maintenance of the station. The river has one channel at all stages and the current is usually favorable for making discharge measurements.

Measurements are made from a car hung on a cable, which was erected at this point during the summer of 1909. Previous to that time the measurements were made by wading.

The low water portion of the curve is well defined. No measurements have as yet been made to determine high water discharge.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Bog River near Tupper Lake, N. Y., in 1909.

DATE.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 8	Covert and Hoyt	50	103	1.38	(*a*)64
July 13	W. G. Hoyt	49	105	1.40	(*a*)70
Sept. 6	W. G. Hoyt	47	89	1.16	(*a*)41
Oct. 1	W. G. Hoyt	44	87	1.17	(*b*)42
Oct. 14	C. C. Covert	49	100	1.24	(*b*)54

(*a*) Measurement made by wading at the station.
(*b*) Measurement made from the cable.

Daily gage height, in feet, of Bog River near Tupper Lake, N. Y., for 1909.

DAY.	July.	Aug.	Sept.	Oct.	Nov.	DAY.	July.	Aug.	Sept.	Oct.	Nov.
1	....	1.22	1.13	1.17	....	17	1.34	1.12	....	....	....
2	....	1.23	1.13	1.20	....	18	....	1.13	1.20	....	....
3	....	....	1.13	....	....	19	....	1.13	....	....	....
4	....	....	1.12	....	....	20	....	1.13	....	....	1.40
5	....	....	1.16	....	....	21	1.16	1.20	....	....	....
6	....	....	1.16	....	1.30	22	....	....	....	....	....
7	....	....	1.12	....	....	23	....	....	....	1.40	1.60
8	1.34	1.12	1.13	....	....	24	....	1.13	....	....	....
9	....	....	1.13	1.30	1.30	25	....	....	1.20	....	....
10	....	1.18	1.13	....	....	26	....	1.13	....	....	....
11	....	1.09	1.14	....	....	27	1.32	1.14	....	....	1.30
12	....	1.22	1.14	....	....	28	....	1.13	....	....	....
13	1.39	1.23	1.13	....	....	29	....	....	....	....	....
14	....	1.11	....	1.24	1.40	30	....	1.13	1.20	1.50	1.40
15	....	1.09	....	....	....	31	....	1.13	....	....	....
16	....	1.13	....	1.25	1.40						

NOTE.— Gage heights are from observations made by E. W. Owen, B. O. Lott and engineers of the Water Supply Commission and U. S. Geological Survey. The stream is partially controlled by power development above the gage. Records from a recording gage were used as a basis for correcting the mean gage height.

Daily discharge, in second-feet, of Bog River near Tupper Lake, N. Y., for 1909.

DAY.	July.	Aug.	Sept.	Oct.	Nov.	DAY.	July.	Aug.	Sept.	Oct.	Nov.
1	....	48.1	38.2	42.4	....	17	63.6	37.2	....	....	....
2	....	49.3	38.2	45.6	....	18	....	38.2	45.6	....	....
3	....	....	38.2	....	....	19	....	38.2	....	....	....
4	....	....	37.2	....	....	20	....	38.2	....	....	72.4
5	....	....	41.3	....	....	21	41.3	45.6	....	....	....
6	....	....	41.3	....	58.2	22	....	....	....	....	....
7	....	....	37.2	....	....	23	....	....	....	72.4	109
8	....	37.2	38.2	....	....	24	....	38.2	....	....	....
9	63.6	....	38.2	58.2	58.2	25	....	....	45.6	....	....
10	....	43.4	38.2	....	....	26	....	38.2	....	....	....
11	....	34.3	39.2	....	....	27	60.9	39.2	....	....	58.2
12	....	48.1	39.2	....	....	28	....	38.2	....	....	....
13	70.9	49.3	38.2	....	....	29	....	....	....	....	....
14	....	36.2	....	50.6	72.4	30	....	38.2	45.6	89.5	72.4
15	....	34.3	....	....	....	31	....	38.2	....	....	....
16	....	38.2	....	51.8	72.4						

Monthly discharge of Bog River, near Tupper Lake, N. Y., for 1908-'09.
[Drainage area, 132 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				Depth of run-off in inches on drainage area.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1908.						
August 24-31	99	89.5	94.2	0.714	0.21	A
September	85.9	11.6	32.1	.243	.27	B
October 1-23	43.4	7.5	27.1	.205	.18	B
1909.						
July 8-31	......	......	(60)	0.454	0.44	C
August	......	......	(42)	.317	.36	C
September	......	......	(44)	.333	.37	C
October	......	......	(62)	.470	.54	C
November	......	......	(68)	.516	.58	C

NOTE.— Monthly estimates for 1909 are based on gage readings, discharge measurements and the record at Raquette Falls.

TABLE OF COMPARATIVE DISCHARGE.

(See next page.)

The accompanying table has been compiled for convenience and for ready reference. It shows the mean monthly and annual discharge in second-feet and second-feet per square mile, for the stations considered in this report. In order to make the years complete it was necessary to estimate portions of, and in some cases, the entire months during the winter season. Such estimates have been based on the best data available, as explained in the preceding text. In this table as well as in the tables of monthly discharge elsewhere printed, such estimates are inclosed in parenthesis, that they may be readily identified.

Mr. Barrows, in his 1908 report, stated that it was probable that the Sacandaga estimates for the year, at Hadley and at Northville were somewhat small. He estimated the Hadley discharge for 1908 as 2.11 second-feet per square mile, and the ratio of unit flow at Hadley with that at Mechanicville as about 1.30. The revised estimates, as published in this report indicate that the 1908 records were small. The recomputations show the discharge at Hadley to be 2.38 second-feet per square mile and the 1909 computations show it to be 2.39. This gives a ratio of unit flow at Hadley with that at Mechanicville of 1.49, for 1908, and 1.53 for 1909.

It will be noted from this table that the Sacandaga river was practically the only stream that had a discharge in 1909 equal to, or greater, than that of 1908. Another significant feature is that the month of low discharge for these streams was either August, September or October and that the minimum discharge for the Hudson and Sacandaga rivers in 1909 exceeded that of 1908, while the minimum discharge of the Genessee and Raquette rivers was smaller. Although the yearly discharge at all of the stations, except as noted above, was smaller, the aggregate monthly discharge of these streams during the low water period was practically the same as for 1908.

Table of comparative discharge.

STATION.	Year.	Area.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
Hudson River at North Creek..........	1907	804	......	......	......	......	......	......	......	......	1,050 1.31	2,120 2.64	2,530 3.15	1,970 2.45	....
	1908	804	(1,300) 1.62	(2,020) 2.51	(2,730) 3.40	5,270 6.55	5,230 6.50	818 1.02	830 1.03	742 .923	525 .653	532 .662	626 .779	(570) .709	1,770 2.20
	1908	804	(622) .774	(1,280) 1.59	(1,180) 1.47	6,290 7.82	5,150 6.41	1,360 1.69	679 .845	773 .961	807 1.00	717 .892	737 .917	(427) .531	1,670 2.08
Hudson River at Thurman.....	1907	1,550	......	......	......	......	......	......	......	......	1,520 .981	2,980 1.92	4,530 2.92	3,580 2.31	....
	1908	1,550	(2,620) 1.69	(3,630) 2.34	(4,750) 3.06	8,520 5.50	7,900 5.10	1,700 1.10	1,410 .910	943 .608	728 .470	779 .503	919 .593	(900) .581	2,900 1.87
	1909	1,550	(1,100) .710	(2,700) 1.74	(2,610) 1.68	9,680 6.25	7,860 5.07	2,990 1.93	1,110 .716	960 .619	913 .589	795 .513	835 .539	(800) .516	2,700 1.74
Hudson River at Mechanicville.........	1907	4,500	10,300 2.29	4,140 .920	9,570 2.13	16,600 3.69	13,900 3.09	5,560 1.24	4,120 .916	2,390 .531	6,150 1.37	9,560 2.12	14,000 3.11	12,000 2.67	9,020 2.01
	1908	4,500	8,410 1.87	9,690 2.15	14,000 3.11	22,300 4.96	17,900 3.98	3,760 .836	2,140 .476	1,770 .393	1,020 .227	1,380 .307	1,850 .411	2,010 .447	7,190 1.60
	1909	4,500	5,210 1.16	11,600 2.58	9,220 2.05	25,800 5.73	17,000 3.78	6,020 1.34	1,980 .441	1,520 .338	1,460 .324	1,560 .347	1,680 .373	1,570 .348	7,050 1.56
Schroon River at Riverbank.....	1907	534	......	......	......	......	......	......	......	......	184 .345	545 1.02	1,530 2.87	1,130 2.12	....
	1908	534	(1,010) 1.89	(1,130) 2.12	(1,300) 2.43	3,160 5.92	2,790 5.22	700 1.31	335 .627	117 .219	160 .300	159 .298	195 .365	(198) .371	938 1.76
	1909	534	(255) .478	(872) 1.63	(1,040) 1.95	3,970 7.43	2,630 4.93	1,110 2.08	343 .642	100 .187	108 .202	110 .206	188 .352	(218) .408	912 1.71
Sacandaga River at Wells.....	1907	263	......	......	......	......	......	......	......	25 .095	185 .703	518 1.97	1,120 4.26	(800) 3.04	....
	1908	263	(450) 1.71	(862) 3.28	997 3.79	3,140 11.9	2,050 7.79	297 1.13	73.6 .280	32.1 .122	18.7 .071	71.2 .271	121 .460	(266) 1.01	698 2.65
	1909	263	(457) 1.74	(931) 3.54	(550) 2.09	3,590 13.7	2,040 7.76	453 1.72	86.8 .330	45.2 .172	23.7 .090	32.7 .124	58.2 .221	(73.6) .280	695 2.65
Sacandaga River at Northville.........	1907	740	......	......	......	......	......	......	......	78.2 .106	550 .743	2,000 2.70	3,420 4.62	3,050 4.12	....
	1908	740	(1,430) 1.93	(2,660) 3.59	(2,880) 3.89	9,600 13.0	6,040 8.16	862 1.16	252 .341	144 .195	63.9 .086	208 .281	389 .526	(446) .603	2,080 2.81
	1909	740	(1,130) 1.53	(2,650) 3.58	(1,580) 2.14	9,210 12.4	4,220 5.70	1,300 1.76	226 .305	189 .255	75.2 .102	157 .212	182 .246	(250) .338	1,760 2.38

Table of Comparative discharge — (Concluded).

STATION.	Year.	Area.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
Sacandaga River at Hadley	1907	1,050	......	......	......	......	......	......	......	......	736	2,260	4,160	3,040	....
											.701	2.15	3.96	2.90	....
	1908	1,050	(1,900)	(3,420)	(3,480)	10,200	7,440	1,300	382	233	138	367	521	637	2,500
			1.81	3.26	3.31	9.71	7.09	1.24	.364	.222	.131	.350	.496	.607	2.38
	1909	1,050	(1,680)	(3,820)	(2,250)	12,300	6,280	1,660	378	352	216	303	387	(456)	2,510
			1.60	3.64	2.14	11.7	5.98	1.58	.360	.335	.206	.289	.369	.434	2.39
Genesee River at St. Helena	1908	1,030	......	......	......	......	......	......	......	294	121	125	168	160	....
										.285	.117	.121	.163	.155	....
	1909	1,030	1,400	2,620	2,010	2,880	2,490	726	158	82.9	88.8	153	210	(173)	1,080
			1.36	2.54	1.95	2.80	2.42	.705	.153	.082	.086	.149	.204	.168	1.05
Genesee River at Jones' Bridge	1908	1,410	......	......	......	......	......	......	......	467	171	151	216	230	....
										.331	.121	.107	.153	.163	....
	1909	1,410	(2,120)	(3,980)	2,590	3,290	3,430	1,040	204	102	112	217	288	(261)	1,470
			1.50	2.82	1.84	2.33	2.43	.738	.170	.072	.079	.154	.204	.185	1.04
Raquette River at Raquette Falls	1908	418	......	......	......	......	......	......	......	115	70.8	114	......	......	....
										.275	.169	.273	......	......	....
	1909	418	......	......	......	......	......	......	263	159	132	154	......	......	....
									.629	.380	.316	.368	......	......	....
Raquette River at Piercefield	1908	723	......	......	......	......	......	......	......	554	220	95.9	133	387	....
										.766	.304	.133	.184	.535	....
	1909	723	641	1,310	1,230	3,390	4,560	1,600	501	282	348	330	270	393	1,230
			.887	1.81	1.70	4.69	6.31	2.21	.693	.390	.481	.456	.373	.544	1.71
Raquette River at Massena Springs	1907	1,170	(3,000)	(650)	(2,000)	3,790	4,210	1,770	1,430	616	606	1,850	2,540	2,000	2,040
			2.56	5.56	1.71	3.24	3.60	1.51	1.22	.523	.518	1.58	2.17	1.71	1.74
	1908	1,170	(3,000)	(2,000)	(4,000)	5,360	6,670	1,990	902	545	343	260	434	(673)	2,180
			2.56	1.71	3.42	4.58	5.70	1.70	.771	.466	.293	.222	.371	.575	1.86
	1909	1,170	(850)	(1,800)	(1,700)	5,170	6,870	2,320	772	468	521	537	527	(550)	1,850
			.726	1.54	1.45	4.42	5.87	1.98	.660	.400	.445	.510	.450	.470	1.58
Bog River	1908	132	......	......	......	......	......	......	......	94.2	32.1	27.1	......	......	....
										.714	.243	.205	......	......	....
	1909	132	......	......	......	......	......	......	(60)	(42)	(44)	(62)	(68)	......	....
									.451	.317	.333	.470	.516	......	....

GENERAL ACCURACY OF RESULTS.

Hudson River at North Creek.

The rating curve at this station for high stages was developed in the spring of 1909. The measurements were all made on the falling stage, therefore this portion of the curve may be slightly small. The low water portion was developed in 1907–08 and substantiated by the work of 1909. It is believed to be representative of the low water flow. Records at this station are considered as conservative during open water periods.

Hudson River at Thurman.

This rating curve was developed in 1907–08 and substantiated by work in 1909. While measurements indicate the curve to be fair, monthly computations, when compared with North Creek and Riverbank, indicate Thurman to be small. This is especially true of April, September, October and November, 1909.

Hudson River at Mechanicville.

These records have been furnished by Mr. R. P. Bloss, of the West Virginia Pulp and Paper Company. A personal inspection of this plant during the summer of 1909, developed the fact that considerable care and attention is given to the observations and, for this type of station, the results should be classed as fair. Intercomparisons with other stations in the Hudson drainage lead to the belief, however, that the discharge as a whole is much too low.

Schroon River at Riverbank.

A very good rating curve was developed at this station in 1907–08 and has been substantiated by work of 1909. Generally speaking the estimates at this station are considered to be within 5 per cent. to 10 per cent. of the actual flow.

Sacandaga River at Wells.

At this station a fairly well defined rating curve has been developed for low water stage, but considerable work is necessary for the high water portion. The estimates, as a whole, can be considered fair. However, logging conditions sometimes interfere during high water periods, which may have a tendency to make the records a little large.

Sacandaga River at Northville.

From January 1st to March 27th, and from December 11th to 31st, no records of the flow were obtained at this station, owing to unfavorable ice conditions. Estimates for this period are based on the records at Wells and Hadley and on climatological data. An excellent rating curve has been developed for low and medium stages but the high water portion is not well defined and considerable work is necessary to complete this section of the curve. No records have as yet been obtained of the flow of the West branch, which unites with the East branch between this station and Wells, hence it is rather difficult to estimate the flow at Northville during months for which records are lacking. As a whole, I believe the results at Northville can be considered fairly representative of existing conditions.

Sacandaga River at Hadley.

The high water portion of this curve was developed during the spring of 1909. Some of the measurements were made at the lower highway bridge and under rather unfavorable conditions, especially those of the highest stage. A large portion of the period of high water is affected by log jams, but as occasional high water measurements have been made under these conditions the curve is considered conservative. The 1909 monthly estimates are believed to be slightly large, especially from August to, and including, December. Otherwise the records seem to be very satisfactory when compared with Wells and Northville.

Genesee River at St. Helena.

The high water portion of this curve was developed in the spring of 1909. Most measurements were made on a falling stage. The low water portion is based on measurements made in 1908–09, and is believed to be very conservative. The records for this station are above the average for Genesee river and the results can be considered conservative throughout the year, as they are seldom affected by ice conditions.

Genesee River at Jones' Bridge.

General conditions are not as favorable as at St. Helena but the monthly estimates for 1909, with the exceptions of January to March and for December are considered good.

Raquette River at Raquette Falls.

Too little information to give any definite opinion.

Raquette River at Piercefield.

High water portion of curve based on discharge measurement made in 1909. Low water portion well defined. General results believed to be conservative. Conditions are favorable for complete yearly estimates.

Raquette River at Massena Springs.

A well defined rating curve has been developed and open water records are considered excellent. Winter estimates based largely on Piercefield records, may be slightly small.

Bog River near Tupper Lake.

Too little information to give any definite opinion.

CONCLUSION.

Generally speaking the estimates are believed to be fairly representative of existing conditions at the various stations and present, in a conservative manner, the mean annual discharge. It is unfortunate that the records do not cover a longer period and that the various stations have not more complete rating curves established.

The records of stream flow are the fundamental basis of future development and control of the state's water resources and it is earnestly recommended that the scope of the work be systematically enlarged, and that existing stations be brought to a point of higher efficiency at an early date. Considerable work is necessary at the majority of the stations to complete the rating curves.

Records of stream flow are of vital importance, not only to the Commission but to the general public. If the State of New York, through the Water Supply Commission, undertakes the systematic and comprehensive development of this natural resource, it must necessarily have these data, not only for its own protection but for the protection of riparian owners in the adjustment of benefits and damages.

Respectfully submitted,

C. C. COVERT,

District Engineer.

ALBANY, N. Y.,

February 1, 1910.

APPENDIX B.

DECISIONS OF THE COMMISSION ON WATER SUPPLY APPLICATIONS.

APPENDIX B.

DECISIONS OF THE COMMISSION ON WATER SUPPLY APPICATIONS.

The following table contains a list of the applications filed with this Commission since its creation, together with the disposition made of each case:

No.	Applicant.	Date of Filing.	Disposition.
1.	City of New York	Nov. 3, 1905.	Approved May 14, 1906.
2.	City of Kingston	Nov. 8, 1905.	Discontinued.
3.	City of Oneida	Dec. 2, 1905.	Approved Mar. 16, 1906.
4.	Village of Lyons Falls	Dec. 26, 1905.	Approved Mar. 28, 1906.
5.	Village of Constableville	Dec. 30, 1905.	Approved Apr. 19, 1906.
6.	City of Watervliet	Jan. 25, 1906.	Dismissed Sep. 25, 1906.
7.	Village of Millbrook	Feb. 21, 1906.	Withdrawn Mar. 5, 1906.
8.	Village of White Plains	Apr. 20, 1906.	Approved June 15, 1906.
9.	City of Lockport	May 24, 1906.	Approved July 13, 1906.
10.	Village of Malone	June 28, 1906.	Approved Jan. 18, 1907.
11.	Village of Holland Patent	Aug. 25, 1906.	Approved Sep. 25, 1906.
12.	Village of Brewster	Oct. 12, 1906.	Approved Feb. 21, 1907.
13.	Village of Bergen	Oct. 18, 1906.	Approved Nov. 8, 1906.
14.	City of Gloversville	Nov. 27, 1906.	Approved Jan. 18, 1907.
15.	Village of Carthage	Dec. 13, 1906.	Approved Mar. 14, 1907.
16.	Hannacroix Water Company	Dec. 22, 1906.	Approved Oct. 17, 1907.
17.	City of Plattsburg	Jan. 19, 1907.	Approved Feb. 27, 1907.
18.	Village of Pleasantville	Feb. 9, 1907.	Approved Aug. 6, 1907.
19.	Village of Seneca Falls	Feb. 21, 1907.	Approved Oct. 16, 1907.
20.	Village of Waterville	Mar. 6, 1907.	Approved May 9, 1907.
21.	Village of Old Forge	Mar. 13, 1907.	Approved May 9, 1907.
22.	Village of Ossining	Mar. 13, 1907.	Approved Nov. 26, 1907.
23.	Village of Peekskill	Mar. 15, 1907.	Discontinued.
24.	Urban Water Supply Company	May 22, 1907.	Approved July 16, 1907.
25.	Village of East Aurora	June 13, 1907.	Approved July 18, 1907.
26.	Martinsburg Water District	July 2, 1907.	Approved July 15, 1907.
27.	City of New York — Modification of Catskill Aqueduct line	July 12, 1907.	Approved Oct. 15, 1907.
28.	City of New York — Schoharie watershed	July 12, 1907.	Discontinued.
29.	City of Rome	July 20, 1907.	Approved Aug. 15, 1907.
30.	Tannersville Water Company	Aug. 23, 1907.	Approved Dec. 21, 1907.
31.	Great South Bay Water Company	Dec. 14, 1907.	Approved Jan. 21, 1908.
32.	City of Gloversville (second application)	Jan. 16, 1908.	Approved Feb. 18, 1908.
33.	Village of McGrawville	Jan. 20, 1908.	Approved Mar. 11, 1908.
34.	Village of Malone	Feb. 12, 1908.	Discontinued.
35.	Village of Bainbridge	Feb. 20, 1908.	Discontinued.
36.	Staatsburg Water Company	Mar. 6, 1908.	Approved Apr. 10, 1908.

No.	Applicant.	Date of Filing.	Disposition.
37.	Village of Briarcliff Manor	Apr. 18, 1908.	Discontinued.
38.	Palenville Water District	Apr. 27, 1908.	Petition not completed.
39.	Harmon Water Company	July 16, 1908.	Withdrawn Sep. 16, 1908.
40.	City of New York — Suffolk county sources	July 29, 1908.	Pending.
41.	Village of East Syracuse	July 30, 1908.	Approved Aug. 14, 1908.
42.	Edmeston Water Company	Aug. 14, 1908.	Approved Sep. 16, 1908.
43.	Village of Marcellus	Aug. 24, 1908.	Approved Sep. 30, 1908.
44.	Village of Shortsville	Oct. 5, 1908.	Approved Feb. 6, 1909.
45.	Village of Clifton Springs	Oct. 5, 1908.	Approved Oct. 14, 1908.
46.	Village of Webster	Nov. 23, 1908.	Approved Dec. 12, 1908.
47.	Syracuse Suburban Water Co.	Dec. 1, 1908.	Approved Apr. 9, 1909.
48.	Village of White Plains (second application)	Dec. 30. 1908.	Approved Nov. 30, 1909.
49.	City of Glens Falls	Mar. 6, 1909.	Approved Apr. 21, 1909.
50.	City of New York — Nassau county sources	Mar. 12, 1909.	Approved May 15, 1909.
51.	Village of Bainbridge (second application).	Mar. 16, 1909.	Approved Aug. 18, 1909.
52.	Fultonville Water Co	Mar. 17, 1909.	Combined with No. 57.
53.	Village of West Carthage	Apr. 7, 1909.	Approved Apr. 22, 1909.
54.	Rensselaer Water Co	Apr. 12, 1909.	Approved Apr. 21, 1909.
55.	City of Niagara Falls	Apr. 20, 1909.	Approved July 14, 1909.
56.	Village of Webster (amended application).	May 5, 1909.	Approved June 15, 1909.
57.	Village of Canajoharie	June 1, 1909.	Pending.
58.	Village of Croghan	June 17, 1909.	Approved Sep. 22, 1909.
59.	Village of Mechanicville	June 22, 1909.	Approved July 13, 1909.
60.	Central Bridge Water Co	July 2, 1909.	Approved July 29, 1909.
61.	Whitney's Point Water Co	July 8, 1909.	Approved July 30, 1909.
62.	Water District of Town of Petersburg	July 15, 1909.	Approved Oct. 14, 1909.
63.	Village of Livonia	July 16, 1909.	Approved Oct. 21, 1909.
64.	Village of Mt. Morris	Aug. 2, 1909.	....
65.	Village of Painted Post	Aug. 18, 1909.	Approved Sep. 3, 1909.
66.	Village of Farmingdale	Sept. 22, 1909.	Discontinued.
67.	City of New York — Modification of Catskill Aqueduct	Dec. 16, 1909.	Pending.
68.	Village of Barker	Jan. 11, 1910.	Pending.
69.	Jamaica Water Supply Co	Jan. 13, 1910.	Pending.

Reproduced below will be found the decisions of the Commission on applications passed upon during the year ending February 1, 1910.

APPLICATION NO. 44.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The application of the VILLAGE OF SHORTSVILLE, Ontario county, N. Y., for approval of its maps and profiles of its proposed source of water supply.
} *Decision.*

Application filed: January 21, 1909.

Hearing: February 6, 1909.

Decision: February 6, 1909.

Willis C. Ellis, Esq., for petitioner.

The village of Shortsville, a municipal corporation organized under the Village Law, is situate in the town of Manchester, Ontario county, N. Y., and has a population of about one thousand.

A proposition to establish a municipal system of water works for supplying the village and its inhabitants with water for potable and fire purposes at an expense not to exceed $30,000, was on the 30th day of July, 1908, adopted by a vote of 114 ballots cast in favor of the proposition to 42 ballots cast against it, and immediately thereafter the board of trustees of the village, by resolution duly adopted, determined to construct and establish a system of village water supply. The village is now without a municipal system. Substantially all the water consumed in the village is obtained from private wells.

The plans contemplate the acquisition of what is known as the Dillon Spring, which is situate in the town of Hopewell, about one-half mile south of the corporate limits of the village, and about two acres of land upon which the spring is located, which practically controls the slope or watershed of the spring. While the water from the spring is quite hard, bacteriologically it is uncontaminated in its present condition and is suitable for all purposes of the household, including drinking.

For fire protection the plan provides for hydrants within 400 feet practically of all buildings within the village, as well as a pipe to the Shortsville Wheel Company plant, which, while it is outside the village limits, is the chief industrial plant in the vicinity. This protection will be secured by a 75,000-gallon steel tank and an elevated tower and a concrete collecting well of 17,000 gallons capacity at the spring well, and it is contemplated that this will furnish three fire streams or 450 gallons per minute for three hours and twenty minutes without pumping. With the use of either unit of the pumping plant this supply will be extended seven hours and a half. The pressure throughout the village will be about seventy-three pounds in the business section. On the high portions of the village, High and Grove streets, Upper Booth street, and Main and Canandaigua streets, this will fall to about fifty-six pounds. This will give a nozzle pressure of thirty pounds through 200 feet of hose, throwing a vertical stream fifty-seven feet and a horizontal stream seventy-eight feet. The sizes of pipes, pumps, etc., are fixed by the fire protection demands rather than by domestic consumption. The capacity of the springs is about 75,000 gallons per day of twenty-four hours, and the spring has never been known to fail.

The assessed valuation of the real and personal property in the village for the year 1908 was $472,000, and there is no other bonded or other indebtedness outstanding against the village except that voted for this water supply.

No other municipality or civil division of the State would be affected by the proposed plan of the applicant.

The State Water Supply Commission, therefore, determines:

(1) That the plans proposed by the village of Shortsville are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps and plans to be acquired by the village of Shortsville for a new or additional source of water supply, and the profiles thereof showing the sites and areas of the proposed reservoirs and other works, the profiles and aqueduct lines and the flow lines of the waters when impounded, plans, surveys and abstract of official reports relative to the same, and the plan to provide for the payment of proper compensation for any and all damages to persons and property, whether direct or indirect, which will result from the acquiring of said lands, and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has caused this determination and approval to be signed by the Commission, and its official seal to be affixed hereto, and the same together with all maps, plans, surveys and other papers relating thereto, filed in its office in the city of Albany, this 6th day of February, 1909.

HENRY H. PERSONS,
President.
ERNEST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 47.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the SYRACUSE SUBURBAN WATER COMPANY.

Decision.

White, Cheney, Shinaman & O'Neill, for petitioner.

Walter W. McGee, for the city of Syracuse.

E. I. White, for Federal Milling Company and others.

Martin F. Dillon, for village of Marcellus.

A. L. Olmstead, for W. D. L. Wilson.

Submitted: March 22, 1909.

Decided: March 30, 1909.

The Onondaga County Suburban Water Company was incorporated in April, 1907, pursuant to the provisions of the Transportation Corporations Law, for the purpose of supplying pure and wholesome water to the towns of Marcellus, Camillus and DeWitt, in the county of Onondaga, and their inhabitants.

As such corporation it was without power to take or use water from any of the canals of the State or any canal reservoirs or any streams which have been taken by the State for the purpose of supplying the canals with water.

Chapter 371 of the Laws of 1907, in effect May 27, 1907, granted authority to this company, for the purpose of supplying pure and wholesome water to municipalities and their inhabitants, under certain restrictions and conditions, to increase the water storage capacity of Otisco lake, a canal reservoir in Onondaga county, so as to impound therein an additional supply of water, to take and conduct water from the lake equal in amount to the additional supply so impounded, and to construct, place and maintain such wall, dam, intake pipe, galehouse gate and structures as may be necessary for such purpose.

The work of construction at the lake is under the supervision and control of the State Superintendent of Public Works and in accordance with plans approved by the State Engineer and Surveyor; the former State officer is empowered to regulate the flow of water from the lake into the intake pipe so as to prevent the company from taking from the lake a supply of water greater than the additional amount so impounded by it so long as water therefrom may be required by the Erie canal.

Before any dam or structure authorized by the act shall be constructed, or any water so taken from the lake, the company was required to "extinguish the riparian rights of the owners of the property upon the shores of

said lake and the outlet thereof affected by the proposed storage and use of said water or obtain their consent thereto."

Pursuant to an order of the Supreme Court, Fifth Judicial District, bearing date September 7, 1907, the Onondaga County Suburban Water Company was authorized to assume the corporate name of the Syracuse Suburban Water Company on and after November 1, 1907.

On November 9, 1907, the authorized capital stock of the company was increased from $50,000 to $600,000.

The company adopted Otisco lake, having a drainage area of forty-four and seven-tenths square miles, as its source of supply, and in August, 1907, entered into a contract with the American Pipe Manufacturing Company for the construction of its plant, in accordance with the plans which were subsequently filed with the State Water Supply Commission; prior to which it had purchased some 110 pieces of property around the lake and obtained some consents from owners of mill property along Nine Mile creek, the outlet of the lake.

From the spring of 1908, up to a short time past, the work of constructing the dam at the lake, under the inspection of the State Superintendent of Public Works, and according to plans approved by the State Engineer and Surveyor, has progressed. Installation of the distributing system has also been under way, some thirty miles of pipe having been laid, and a distributing reservoir near Amboy and Fairmount started. At the present time all work has ceased. None has been completed. No water has been taken from the lake.

On December 1, 1908, the company submitted its maps and profiles of the sources of its water supply, with its plans and surveys, etc., and its application for the approval thereof, to the State Water Supply Commission.

These plans and the evidence given on the hearing herein show that the applicant under the authority given it by chapter 371 of the Laws of 1907, and in accordance with the plans approved by the State Engineer and Surveyor, proposes to raise the level of Otisco lake four feet; the present level of the lake was established by the dam erected by the State in 1869, and is ten feet above the natural level. From this increased storage a gravity distributing system, which is limited to 5,000,000 gallons per day, will supply water to the towns of Marcellus, Camillus and DeWitt, and the inhabitants thereof. The distributing system is substantially as follows:

From the intake crib in the lake a 24-inch iron pipe conducts the water to a point 1½ miles north of the dam, and from that point a 20-inch pipe is laid down the Nine Mile creek, the outlet of the lake through the villages of Marcellus and Camillus to a place called Fairmount, a distance of 13 and 76/100 miles. At Fairmount a distributing reservoir of 4,000,000 gallons capacity is to be constructed, connected with the main line by some 1,900 feet of 20 and 24 inch pipe; from this point a branch line of 2 and 56/100 miles of 8-inch pipe is also extended to Amboy Station, on the New York Central and Hudson River railroad.

Continuing from Fairmount the main line extends with 1.15 miles of 24-inch pipe, and 2.35 miles of 20-inch pipe to Solvay, from which point follows 9.6 miles of 16-inch pipe around Onondaga lake and through a part of the city of Syracuse to the villages of Eastwood and East Syracuse, and 2.28 miles of 12-inch pipe to Manlius Station, on the New York Central and Hudson River railroad, which is the end of the main line distributing system. This system is about 34 miles long, passing through the towns of Marcellus, Camillus, Geddes, Salina, DeWitt and Manlius and the city of Syracuse, all in Onondaga county. From Otisco lake its general direction is northerly to Marcellus Station, from which place it circles toward the east, passing around and through a portion of the northerly section of the city of Syracuse, and continuing in an easterly direction of the end of the line at Manlius Station.

Otisco lake lies wholly within the county of Onondaga, a very small portion of its watershed being in Cortland county. Its waters are suitable for potable purposes, but up to the present time such use of these waters has not been had by any municipality or civil division of the State. This source of supply is available to the entire territory through which the distributing system of the applicant extends. To the communities not having a municipal supply it appears to be the only source from which a safe water supply can be obtained though, as the distance from the lake increases the cost of construction practically prohibits the small communities from using its waters without combination with others.

In the order of proximity to the lake, and within the available area of use of its waters, the following municipalities and civil divisions are considered as affected by the plans of the applicant:

The village of Marcellus has lately installed a municipal water system, with the approval of the State Water Supply Commission, taking its water from another watershed.

The village of Camillus, having a population of about 800, and distant about thirteen miles north of the outlet of the lake, is without a municipal supply. It has made a contract with the applicant for a supply of water for its municipal purposes, the proposition to make the contract having been adopted by an almost unanimous vote of its electors. This village has not the financial ability to install a separate system.

The village of Solvay, of about 4,000 population, has a municipal supply — at this point is situated the Solvay Process Company, employing between 3,000 and 3,500 persons. It requires a large amount of water for boiler purposes, and it cannot advantageously use the water from the village supply for its purposes on account of the hardness of the water, and this company has made a contract with the applicant to furnish it with one and one-half million gallons of water per day for use in its manufactories.

Along the eastern shore of Onondaga lake there is quite a territory, including Liverpool, a small village that is not supplied with water. Onondaga lake is not available to this section on account of the sewerage from the city of Syracuse and the refuse from the Solvay Process Company.

The city of Syracuse has an abundant supply of water which it obtains from Skaneateles lake, but it appears to be without authority to supply water to other communities, or for industrial purposes outside of the city limits.

The village of Eastwood, having a population of about 900, is also without a municipal supply.

At a special village election, by a vote of sixty-six in the affirmative to nine in the negative, its electors authorized the authorities to make a contract with the applicant for a supply of water for fire and municipal purposes.

This contract has been entered into: Eastwood has not the financial ability to install a municipal system, especially if it seeks to obtain its supply from Otisco lake, which is about twenty-five miles distant.

East Syracuse, having a population of between three and four thousand, has an established municipal water supply system.

At this point the largest railroad yards of the New York Central and Hudson River railroad are situate, and here and also at Amboy the applicant has contracted to furnish to the railroad company one and one-half million gallons of water per day for its shop, boiler and locomotive and general railroad purposes outside of the city of Syracuse.

The railroad company, as was shown, was greatly in need of this additional supply of water for the purposes named. There is necessity for a water supply to the populous industrial area embraced within the service of the distribution system of the applicant.

The objections that were filed by the village of Marcellus and the city of Syracuse which are pertinent to inquiry before this Commission are overcome by the plans filed and the testimony produced upon the hearing. The plans for the construction of the works at the lake have been approved by the State Engineer and Surveyor and meet also our approval. The State Water Supply Commission does not assume to grant the applicant the right to lay its water pipes within the city of Syracuse, or within any of the towns through which its distributing system passes; that right the applicant must obtain from the city of Syracuse and the several towns and villages affected.

The objections filed by Carrie E. Sims, The Paddack Tube Paper Company, the Amboy Paper Mills, Federal Milling Company, Alfred H. Hinsdale, James M. Jackson, Allen V. Smith, and Simon D. Paddack, are to the extent that the same are applicable before this Commission, overcome by force of the Transportation Corporations Law and by the plan of the applicant for the determination and payment of the damages resulting respectively to them from the execution of its plans.

This plan or scheme is as follows:

That your petitioner presents the following as its plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans, namely: To acquire by purchase the lands that may be required for the execution of the plans of your petitioner and to secure conveyance and release thereof if the amount can be agreed upon, and if such amount cannot be agreed upon, then to acquire the same by condemnation proceedings in the form and manner declared by the statute in such case made and provided; and that any person claiming to be damaged, either directly or indirectly, in person or in property, by the acquisition of the lands and the execution of the plans hereinbefore set forth, their heirs, assigns or personal representatives may file a statement of such claim with your petitioner, and that your petitioner will make a reasonable effort to adjust and pay such damages, if any; and if a claim for such damages is not adjusted and an action is brought in any of the courts of this State to recover the same your petitioner hereby stipulates, agrees and consents that the court in which such action is brought shall not be limited in the reception of evidence on the proof of such claim to the rule regulating the proof of direct damages. That to this end your petitioner is in possession of funds, and has the ability to acquire funds ample and sufficient for all the purposes aforesaid.

The State Water Supply Commission finds and determines:

(1) That the application of the Syracuse Surburban Water Company and the plans submitted for a new and additional source of water supply are justified by public necessity.

(2) That the plans of the Syracuse Suburban Water Company, under which it will be able to divert 5,000,000 gallons of water per day from Otisco lake, and as provided by chapter 371, Laws of 1907, are just and equitable to the other municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That said plans make fair and equitable provisions for the determination and payment of all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps of the lands to be acquired by the Syracuse Suburban Water Company for a new or additional source of water supply and the profiles thereof showing the sites and areas of the proposed reservoir and other works, the profiles of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys and abstracts of official reports relating to the same; and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same with all plans, maps, surveys and other papers relating thereto filed in its office at the city of Albany, this 30th day of March, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners

APPLICATION NO. 48.

STATE OF NEW YORK—STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the BOARD OF WATER COMMISSIONERS OF THE VILLAGE OF WHITE PLAINS for the approval of the New York State Water Supply Commission of a proposed plan to take the headwaters of the Mamaroneck River as a source of Water Supply for the Village of of White Plains.
} *Decision.*

Application filed: December 31, 1908.

Hearings at Village of White Plains, February 9, 1909; from time to time at the City of New York, and at the City of Albany, November 11, 1909.

Decision: November 30, 1909.

The State Water Supply Commission having upon the day specified in the notice of public hearing in the above-entitled matter, and upon such subsequent days to which the hearing was adjourned, examined the maps and profiles of said application and heard the proofs and arguments submitted in support and in opposition to the proposed project, and due deliberation having been had thereon, determines:

(1.) That the plans proposed by the board of water commissioners of the village of White Plains for a new and additional source of water supply for the village of White Plains are justified by public necessity.

(2.) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3.) That said plans, as modified by the applicant upon the first hearing, make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The said State Water Supply Commission does hereby approve the application of the board of water commissioners of the village of White Plains as presented.

IN WITNESS WHEREOF, the State Water Supply Commission hath caused this decision to be made and signed and hath caused its official seal to be affixed and the same, with all plans, maps, surveys and other papers or records relating thereto filed in its office in the city of Albany, New York, this 30th day of November, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 49.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the CITY OF GLENS FALLS.
} *Decision.*

Application filed: March 6, 1909.

Hearing at Glens Falls, March 24, 1909.

Decision: April 21, 1909.

The petition of the city of Glens Falls by its Board of Water Commissioners, together with the maps, plans and profiles and the proof produced at the hearing held in the city of Glens Falls, on March 24, 1909, and by affidavit subsequently filed, set forth the following facts:

The city of Glens Falls was incorporated under chapter 29 of the Laws of 1908, which took effect on April 6, 1908. The city has at present over 15,000 inhabitants and is growing slowly but steadily. There has been an increase in the population of 5,000 within the last fifteen years. The present assessed valuation is $6,989,797, including $5,728,997 in real property. There are approximately 3,100 buildings of all kinds within the city limits, including five large blocks with stores and ten factories which use considerable amounts of water. About 100 new houses are built every year.

The present bonded indebtedness of the city is $403,000, including $48,000 City Hall bonds, $88,000 school bonds, $162,000 sewer bonds, $80,000 water bonds, and $25,000 of sewer bonds authorized but not yet issued. The limit of bonded indebtedness on the basis of the present assessed valuation is in round numbers $690,000.

For many years past the city and the former village of Glens Falls has obtained its public water supply by the gravity system from two streams known as the Wilkie and Keenan brooks, supplemented in recent years by the waters of a third stream known as the Butler brook.

The Keenan brook drains into the Hudson river and the Wilkie brook into Lake Champlain. The present impounding and distributing system includes two storage and three distributing reservoirs. The storage reservoirs are known as the Keenan and Wilkie reservoirs respectively, from the brooks on which they are situated. The first has a capacity of 200,000,000 gallons when full and the second 50,000,000 gallons. The Keenan reservoir has .96 sq. mi of watershed and is fed by two streams running into its upper end. The watershed of the Wilkie reservoir is small (.12 sq. mi.) as it is located on the top of a mountain and is fed partly by springs and partly by the run-off from the mountain slopes. The Keenan reservoir was constructed about 1892, but the Wilkie reservoir is much older.

The three distributing reservoirs are located at various points on the mountain, and pipe lines from each come together at a point known as the Upper Junction, about a mile east of the mountain. From this point a 24-inch main and a 12-inch main run together to the so-called the lower junction, about two miles outside the city. From the lower junction one 12-inch main runs into the city by way of Glen street and one 16-inch main by way of Dixon road.

At the present time 3,200 consumers are served by the city system at flat rates, only seven meters being in operation. The water is used not only for domestic service but by practically all the manufacturing plants in the city, as well as for the public purposes of fire protection and flushing sewers. There are a few small water motors in use. The average daily consumption per capita is about 100 gallons, rising in the summer to from 150 to 175. The storage capacity of the two impounding reservoirs when full is equivalent to about 125 days' supply.

The system of fire protection consists of 4-way and 5-way hydrants with steamer connection. A fire department of thirty-two men has at its command three hose wagons, a chemical, a hook and ladder company and one steamer. There are no cisterns in the city for the use of the steamer, which is dependent entirely upon the hydrants of the city system, except that water could be taken from the Champlain canal during the open season for the protection of two or three manufacturing plants near by. With this exception the entire fire protection, as well as the water sprinkling system is dependent upon the water supply system of the city. The gravity pressure is sufficient for an ordinary fire, and in case of greater need the steamer is used.

The need of the city for an additional storage reservoir is evidenced by the fact that in time of drought much care has to be exercised in the use of water. During the summer of 1908 it was necessary to request consumers to be economical in the use of water, and a general inspection of all plumbing fixtures of the city was made to detect leaks and have them repaired. The use of garden hose and fountains was discontinued and the consumption of water thus decreased from approximately two million gallons per day to about one million. Considerable complaint has been made as to the lack of sufficient water, although little complaint is made as to quality. In the summer it has been necessary also to discontinue the use of water for flushing sewers. The city has approximately sixty automatic sewer flush tanks holding about thirty gallons each, and arranged to discharge as often as they fill, once in five minutes. The water has to be shut off from these tanks usually some time in June, or as soon as it becomes necessary to draw on the storage to feed the city. The result of discontinuing this service when it is most needed is that the water in the traps evaporates, resulting in the escape of sewer gas and causing offensive odors which give rise to complaints.

In the year 1905, with the purpose of supplementing the supply from the Wilkie and Keenan reservoirs, the city erected a small concrete dam on the Butler brook at an expense of approximately $1,200. This dam and the reservoir created thereby are too small, however, to provide a quantity of water adequate to the growing needs of the city. In view of these facts the present application has been made for permission to construct a dam and reservoir on the Butler brook about one-eighth of a mile above the small dam just mentioned. The plans propose a dam 470 ft. long upon the crest, with its greatest depth nearly in the center where it crosses the present creek bed.

The spillway is of original design and consists of a chamber in the center of the dam 25 ft. long, 60 ft. high, and 8 or 9 ft. wide at the top tapering to a width of between 7 and 8 ft. at the bottom. It is intended that the water shall spill through this chamber in the dam and pass out through a culvert at the bottom. The dam is planned to be of earth, with a masonry core wall extending down to an impervious foundation. The reservoir created by this dam will gather the supply from a watershed of 2.4 square miles.

It appears from the evidence produced at the hearing that the only other municipal corporation in any way affected by the proposed plan is the town of Queensbury, Warren county, of which Daniel P. DeLong is supervisor. This town is a sparsely settled farming community, each inhabitant of which has a sufficient individual water supply, so that the present project involves no injustice to the present or future needs for water supply of any other municipality or civil division of the State.

The city's financial ability to undertake this project is clear. It was shown on the hearing that the city proposes to pay for the extension from its existing surplus of receipts from water rents and by issue of bonds for which the city has adequate authority. The financial condition of the water system is excellent, the annual income having increased from $25,349.86 in 1904 to $40,710.08 for the year ending May 1, 1909. Against this income is charged maintenance and extension expenses and interest on bonds and payment on the principal. The charter provides that the Water Commissioners may spend $10,000 a year for extensions and $12,000 for maintenance, holding the balance as a reserve until it reaches $35,000. Although provision is made that this surplus may be loaned in part to the common council, such a loan has never been made, and the surplus for the year ending May 1, 1909, amounted to $13,904.15.

The analyses of water from the Butler brook produced in evidence show that the water of the several city reservoirs is of good quality. The evidence of previous examination shows that at times the supply is subject to contamination, probably due to the existence of houses and stables on the watersheds, as shown by the testimony. It was stated at the hearing that although regulations had been made for the sanitary protection of the watersheds, these regulations had never been approved by the State Board of Health and no regular system of inspections had been established. It is highly desirable that such inspection should be made to locate every possible source of contamination and measures taken to correct the same, so that the excellent natural quality of the city's supply may be preserved.

Objections to the granting of the application were made by the Kanes Falls Electric Company and by G. Jenkins Sons, both on the ground of diversion of water needed for power plants on the watershed of the Butler brook below the proposed reservoir. These objections were not pressed on the ground that there was no public necessity for the additional supply and are overcome in their effect by the stipulation of the city made at the hearing, that if any person presents a claim for damages to the city of Glens Falls on account of the execution of these plans, the city will make an effort to agree with him, and if it cannot agree with him, any court or commission to whom the matter may be referred shall not be limited in the reception of evidence to the proof of direct damages.

The city produced evidence on the hearing that it now owns nearly all the land on which the proposed reservoir is to be built, and has extensive water rights on the Butler brook.

This Commission therefore finds and determines:

(1) That the plans proposed are justified by public necessity.

(2) That the same are just and equitable to the municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and

(3) That such plans as modified make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of the plans.

The application is therefore approved.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has made and signed this decision and caused its official seal to be [L. S.] affixed thereto, and has filed the same, together with all maps, plans, surveys, and other papers or records relating thereto in its office, this 21st day of April, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 50.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the CITY OF NEW YORK to the STATE WATER SUPPLY COMMISSION for its approval of certain maps, plans and profiles prepared by the Commissioner of Water Supply, Gas and Electricity, in order that certain lands in the county of Nassau may be acquired for an increase in the supply of water to the city of New York.
Decision.

Filed: March 12, 1909.

Hearings: March 26, April 2, 3, 7, 9, 1909.

Decided: May 15, 1909.

On the 12th day of March, 1909, pursuant to the provisions of chapter 723 of the Laws of 1905, and the acts amendatory thereof and supplemental thereto, the city of New York filed its petition with this Commission asking for the approval of its maps, plans and profile for a new or additional source of water supply for the borough of Brooklyn.

The petition contains a copy of the resolution adopted June 19, 1908, by the Board of Estimate and Apportionment of the city of New York, approving the map and plans prepared by the Commissioner of Water Supply, Gas and Electricity of the city of New York, for a new and additional source of water supply to be taken from the county of Nassau for said borough. The petition states that the proposed plan for acquiring the additional water from the new source will not injure or affect in any manner any streams or sources of water other than those shown on the map, plan and profile filed with this Commission, and alleges that the plan is just and equitable to other municipalities and civil divisions of the State.

It is the purpose of the city, as shown by its application, to acquire by purchase the necessary property and rights for the extension of its present municipal water plant, and in case purchase cannot be made by negotiation to acquire such property and rights by condemnation and to pay, in either event, any and all damages, whether direct or indirect, which will result from the acquiring of the lands and execution of the proposed plans. The petition sets forth the ability of the city of New York to meet such expense and the manner in which the city proposes to raise the funds for defraying the cost of the project. The map, showing the proposed plan and signed by John H. O'Brien, Commissioner of Water Supply, Gas and Electricity, and the Hon. George B. McClellan, Mayor of the city of New York, was filed with a certificate of its adoption, in the office of the Commissioner of Water Supply, Gas and Electricity on the 19th day of June, 1908. A copy of this map was also filed in the county clerk's office of Nassau county on the 11th day of August, 1908.

At the hearing, George L. Sterling, Acting Corporation Counsel, and Josiah A. Stover, appeared for the city of New York, and filed proof of publication of the notice of hearing.

The village of Rockville Center filed objections and appeared by George A. Wallace.

Robert Davison and Herbert Davison filed objections and appeared by John Lyon.

The village of Freeport filed objections and appeared by Leo Fishel.

The Queens County Water Company filed objections and appeared by William DeForest Baldwin.

William Bonner filed objections and appeared by Albert E. Seibert, representing Seibert, Paddock & Cochrane.

Edgar Jackson and George W. Wright appeared by Earl J. Bennett.

The Cochrane Realty Company appeared by Theodore M. Ripsan.

Thomas P. O'Connor and others appeared by James Neiman.

The Nassau-Suffolk Lighting & Heating Company appeared by Martin V. B. Hall.

This application involves the expenditure of a large amount of money and when finally carried out will provide water for the borough of Brooklyn for only a short period of years. We find from a study of the evidence in these proceedings that the water supply of the city of New York for the borough of Brooklyn is obtained from three sources:

(a) Driven well stations owned by the municipality within the limits of the borough, which pump ground water from wells directly into the mains of the distribution system. There are three of these stations operated by the city and they delivered in 1908 an average supply of 11,200,000 gallons per day. There is also a fourth station now operated under contract with the city, which becomes the city's property in about three years. This station yielded in 1908 an average daily supply of 2,800,000 gallons, making the total yield from this first source only 14,000,000 gallons daily.

(b) Three private water companies in the borough: The Flatbush Water Company, the Blythebourne Water Company and the German-American Improvement Company. These companies obtain their supply from the ground water by means of driven well stations of the same character as those of the municipal works, and furnish water to the twenty-ninth and portions of the thirtieth and thirty-second wards of the borough. The water is pumped into stand pipes and distributed in the mains laid and operated by these companies. In 1908, a total supply of about 14,000,000 gallons was pumped from these stations for the supply of the above districts.

(c) From the Ridgewood System, which consists of surface and ground water collecting works in Queens and Nassau counties. The original Brooklyn works constructed as far as Rockville Center and later extended to Massapequa, collect water from many of the surface streams in southern Queens and Nassau counties. Subsequently, driven wells and infiltration galleries were built on the line of the original works to intercept the southerly moving ground waters in the porous sands and gravels of the sub-strata. These surface and ground waters flow by gravity or are pumped through brick aqueducts and pipe lines to the Ridgewood Pumping Station near the westerly limits of Brooklyn borough, where the water is pumped into holding reservoirs and conveyed in the distribution mains to all parts of the borough. In 1908, an average daily supply of about 127,000,000 gallons was delivered by the Ridgewood system to Brooklyn borough.

The total average yield of all the present sources of supply in 1908 was 155,000,000 gallons per day which represented the average consumption of the borough for the past year. The evidence in these proceedings shows that even this consumption of 1908 cannot be maintained during a year of low rainfall by the present works supplying the borough. An attempt to obtain a greater yield than this from the present works would result in drawing an additional amount of sea water from near-by salt water creeks and bays, the influence of salt water having already been felt at some of the pumping stations in the westerly portion of the Ridgewood system. By improving the present works as contemplated by the petitioner, it will be able to collect the water from the available watershed in Kings, Queens and Nassau counties, amounting to 100 square miles. This it is claimed by the city will provide for the increase in consumption for not to exceed five years if ample rainfall occurs. Before the expiration of such time it is clear that the applicant will be compelled to look for still another additional source of water to meet the growing demands of this borough.

The borough of Brooklyn is increasing in population at the rate of 16½ per cent. every five years, or nearly 40,000 people per year. This increase in population, together with the increase in the use of water in manufacturing plants, adds to the water consumption in this borough 8,000,000 gallons per day per year. If the present rate of increase in population and in the use of water continues, it is safe to say it will require 162,000,000 gallons per day for this borough in 1909, 170,000,000 gallons per day in 1910, 178,000,000 gallons per day in 1911, and approximately 268,000,000 gallons per day in 1915.

In years of low rainfall it will be impossible to operate the present system so as to prevent a water famine in parts of the borough of Brooklyn and in the top stories of high buildings during the hot, dry weather, the season of greatest consumption. With such a condition confronting the people of the borough of Brooklyn, it is clear that it is the duty of the officials having charge of the water supply of this borough to prepare to meet such increasing consumption. The damages that would follow a water famine in this great borough would be difficult to estimate; not only the business and comfort of the borough would suffer but the health of the people would be put in jeopardy. It is not the part of wisdom to wait until this great centre of population and industry is overtaken by a water famine before providing for the steadily increasing consumption.

The transportation works of the Ridgewood System which are shown on the accompanying diagram constitute a combined gravity and pumping system. Beginning at Massapequa, the most easterly of the supply ponds and pumping stations, the surface and ground waters are now delivered to a brick conduit 38,000 feet long, which conveys them by gravity to the Millburn Pumping Station.

From this station, most of the water delivered by the conduit is pumped directly under pressure to the Ridgewood Pumping Station in Brooklyn borough through two parallel lines of 48-inch cast-iron pipes 79,000 feet long; the remainder is pumped through a cast-iron pipe to the old brick conduit, so called, at Smith's pond. This pipe is forty-eight inches in diameter from the Pumping Station to the Millburn Storage Reservoir, a distance of 8,000 feet and thirty-six inches in diameter from this reservoir to Smith's Pond, a further distance of 8,500 feet.

The old brick conduit from Smith's Pond to the Ridgewood Pumping Station receives a portion of the delivery from the Millburn Pumping Station, as above stated, and also receives the surface and ground waters collected along this line and delivers its entire flow by gravity to the Ridgewood Pumping Station.

In addition to these conduits, a 72-inch steel pipe line has been constructed from a point not far from the Ridgewood Pumping Station to Clear Stream, a distance of 43,000 feet. This pipe now receives the supply from several driven well stations, and the water is pumped under pressure to Ridgewood through a 48-inch cast-iron pipe from the end of the 72-inch steel pipe, a distance of about 100 feet.

The carrying capacity of the Ridgewood conduits at Ridgewood is estimated at 135 to 140 million gallons per day, 120 to 125 million gallons of which may be transported daily by the brick conduit and the two 48-inch cast-iron pipes, and about 15,000,000 gallons daily by the 72-inch steel pipe as now operated. The old brick conduit which was built fifty years ago is greatly in need of repairs, which cannot now be made without creating a shortage of water in Brooklyn borough. This conduit carries about 70,000,000 gallons at its westerly end, and an accident to it which could not be repaired in two days would result in a water famine. The necessity for an increase in the carrying capacity of the Ridgewood works to provide a safe margin above the average daily delivery is apparent.

The 72-inch steel pipe line, as now constructed, provides sufficient conduit capacity in the westerly portion of the Ridgewood watershed, but beyond the end of this line at Clear stream, the margin between the average yield of the existing surface and ground water works, and the conduit capacity is small, and it has frequently happened at times of large demand that there has been an abundance of water stored in the surface reservoirs and in the ground in the easterly portion of the watershed when there was a shortage in Brooklyn borough. The maximum consumption of Brooklyn in the summer may be 15 to 20 per cent. above the average, and there should be sufficient capacity in the conduits to meet such demands, because it is not practicable to create great storage reservoirs within the limits of Brooklyn borough. The conduit lines of the present system are inadequate to carry to Brooklyn borough the additional supply which may be obtained from new driven well stations as proposed by the applicant.

The plan of the city of New York is to extend the 72-inch steel pipe from Clear stream to the Suffolk county line at Amityville and to construct two pumping stations, one at Wantagh and one at Massepequa. This new line will provide an additional carrying capacity of 50,000,000 gallons per day, which will be sufficient to transport all of the water that may be obtained in the Ridgewood watershed. On the completion of this 72-inch steel pipe line and the pumping stations as proposed, the supply from the easterly portion of the watershed will be delivered through this steel main against the full distribution pressure, without passing through the Ridgewood Pumping Station.

Some evidence was given upon the hearing for the purpose of showing that the average per capita consumption of water in the borough of Brooklyn is abnormally high when compared with that of foreign cities. Such may be and probably is the fact. The customs and conditions there, however, are different from the customs and conditions here. The general use of water for baths, closets, lawn and street sprinkling, and in factories is on the increase in all American cities, and all of these uses should be encouraged. The average per capita consumption of water in the borough of Brooklyn does not vary much from the average per capita consumption in other large centers of population in America. It is the increasing average consumption in American cities that should set the standard in this case. A careful consideration of the evidence produced at the hearing, giving due weight to the growth of the borough and the future increase in the consumption of water, compels the finding that the plans proposed by the city of New York for a new and additional source of water supply for the borough of Brooklyn are justified by public necessity.

It therefore becomes our duty to permit this municipality to increase its water supply when conditions like these demand it, if the rights of other municipalities and property rights can be protected in the manner the law provides.

An effort was made at the hearing to show on behalf of the objectors that the installation of additional pumping stations by the applicant as proposed would be fraught with the gravest consequences to the public and private sources of water supply of the citizens and municipalities of Nassau county. It is shown by the evidence that the natural water table or level of saturation of the underground water is depressed in the form of an inverted cone for a certain distance around each pumping station, this distance depending upon the amount of water extracted and the porosity of the soil. As fast as water is extracted from the soil surrounding a given station, air fills its place in the vicinity and water flows in gradually from more distant regions. It has been found by extended examinations and frequent tests that the resultant of these two forces depresses the normal level of the water table in the form above indicated, and in some instances admittedly to a distance of half a mile from the station. The distance of the line of depression from the central station varies in different directions from the well, depending on the direction of the natural current in the underground water. It was admitted by the witnesses for the applicant that immediately north and south of the line of stations and infiltration galleries the ground waters within a distance of one to two thousand feet would be lowered in existing wells. The Commission recognizes the fact that the construction of these proposed new pumping stations and others that may be built under subsequent plans may have an effect on the available quantity of water to be used for private and public sources of supply in Nassau county.

To what extent the intercepting of the surface and ground water flow by the applicant will reduce the supply at present available for local consumption cannot now be determined, as so much will depend upon the rainfall and the amount of water intercepted. Neither can the amount and nature of the damages, if any, that will be done to farm land and other property interests be fixed at this time. The amount of such damages, both direct and indirect, must be left for another tribunal to determine. Under the command of the statute, the Commission is directed to see that the plans as presented to it, or as it may modify them, "are just and equitable to the other municipalities and civil divisions of the state affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and whether said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans."

These interests the Commission must protect in the manner and to the extent required by statute. One of the provisions made by the applicant for future fair and equitable dealing with the municipalities that may be affected by the execution of the proposed plan resulted in the preparation and enactment into law at the last session of the Legislature of the bill known as the Miller bill. This law, chapter 350, Laws of 1909, provides that it shall be lawful for any municipal corporation in the county of Nassau to take and receive a supply of water for the uses and purposes of such municipal corporation and its inhabitants, from any of the reservoirs, aqueducts, conduits, streams or pipes belonging to the city of New York, located in Nassau county, on complying with reasonable rules and regulations, and on payment therefor at a price to be agreed upon. In case any material dispute shall arise in relation thereto, the question shall be submitted to the State Water Supply Commission for an adjudication thereof. The city also entered into a stipulation with the villages of Rockville Center and Freeport which recites as follows:

"*It is hereby stipulated and agreed,* Subject to the approval of this Commission, by and between the applicant herein, the city of New York, and the incorporated villages of Rockville Center and Freeport, objectors to the approval of the said map, plans and profiles heretofore filed by the applicant with the Commission, as follows:

"The applicant, the city of New York, agrees that if any driven well station or infiltration gallery erected upon the land proposed to be acquired under this application does hereafter interfere with and reduce the water supply available at the now existing pumping stations of the municipal water works of the incorporated villages of Rockville Center and Freeport to such an extent that the present average yield of 750,000 gallons per day at said Rockville Center station and 750,000 gallons per day at said Freeport station may not be obtained, then and in such event the city of New York agrees to furnish without compensation therefor to the village of Rockville Center the number of gallons of water per day, not to exceed 750,000 and to the village of Freeport the number of gallons of water per day not to exceed 700,000 that shall, by the operation of said driven well stations or infiltration galleries become unavailable at the said now existing pumping stations of the municipal water works of Rockville Center and Freeport.

"In consideration of the foregoing agreement on the part of the applicant, the city of New York, the incorporated villages of Rockville Center and Freeport hereby withdraw their objections to the approval of this application."

The parties to this stipulation understood at the time it was made that the enforcement of its conditions should be made to apply not only to those villages whose attorneys signed the stipulation, but to all other municipalities that may be similarly affected by the execution of the applicant's plans.

It is therefore made a condition of granting this application that the conditions of such stipulation shall apply to the villages of Rockville Center and Freeport and to all other municipalities similarly affected.

The villages of Rockville Center and Freeport passed resolutions in relation to the use of the surface of the strip of land running through those villages to be taken by the city of New York. These resolutions read as follows and are Exhibits "L" and "M."

EXHIBIT "L."

"*Whereas,* The city of New York is about to acquire for purposes of water supply, a strip of land in the village of Rockville Center 100 feet or thereabouts in width and running from Merrick road on the west to a point 369 feet or thereabouts east of Morris avenue on the east being known as Parcels 154 to 214 both inclusive, and a portion of Parcel 215, 100 feet wide, bounded on the north by the north line of Parcel 214 extended easterly in a straight line upon a certain map adopted by the Board of Estimate and Apportionment of the city of New York on the 19th day of June, 1908, and

"*Whereas,* It has been requested by certain of the citizens of Rockville Center that this strip be allowed by said city to be used by said village for the purposes of a public road or parkway,

"*Now, therefore, be it resolved,* That if the said city of New York shall allow the said strip to be used for the purposes of a public road and parkway, the village of Rockville Center will accept the same as such and grade, improve, repair, light, police, and in all respects treat the same as one of the streets of the said village; it being expressly understood and agreed that the said city may when necessary for the purposes of installing, maintaining, or repairing any of its structures used for purposes of water supply, enter exclusively at any time upon any part of said strip completing any work done thereon in as reasonable time as may be commensurate with the work to be done, the obligation to replace the said strip in condition for use as a road and parkway being both upon said city and the said village, namely; the said city shall fill up any excavation that it shall make, and after this has been done, the said village shall put the crown of the road itself in condition for use as a road and highway, the use of said strip by the said village being subordinate to the use of the same by the said city for purposes of water supply, and be it further

"*Resolved*, That in the event above specified the village of Rockville Center will save harmless the city of New York from any and all causes of action or damages arising or alleged to have arisen by reason of said strip being used as a road and highway as aforesaid, except that the said city shall be responsible for any and all causes of action or damages arising out of its own negligence on any part of said strip, and be it further

"*Resolved*, That the village of Rockville Center reserves any and all rights or causes of action that it may have against the city of New York to prevent or restrain the said city from interfering in any manner with the Rockville Center municipal water plant and its water supply, and nothing contained in this resolution shall be construed as an acquiescence by the village of Rockville Center to any such interference, either at the present time or in the future."

Signed by GEORGE W. SMITH,
President.

Attest:
GEO. W. RORER,
Village Clerk.

STATE OF NEW YORK,
COUNTY OF NASSAU,
The Incorporated Village
of Rockville Center.
} *ss.:*

I, GEORGE W. RORER, clerk of the incorporated village of Rockville Center, do hereby certify that the foregoing is a true and correct copy of a resolution duly enacted by the board of trustees of said village, at a special meeting of the said board, held at its regular place of meeting, on the 6th day of October, 1908, and the whole thereof, as entered upon the minutes of the proceedings of said board kept by me as village clerk.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the corporate seal of said village, this 7th day of October, 1908.
[L. S.]

GEO. W. RORER,
Village Clerk.

EXHIBIT "M."

"*Whereas*, The city of New York is about to acquire for purposes of water supply, a strip of land in the village of Freeport one hundred feet or thereabouts in width running from Bay View avenue on the west to Liberty avenue on the east, being known as Parcels 265 to 331, inclusive (as to 317 a strip

100 feet wide only), upon a certain map now before the Board of Estimate and Apportionment of the city of New York, for adoption, and

"*Whereas,* It has been requested by certain of the citizens of Freeport that this strip be allowed by said city to be used by said village for the purposes of a public street,

"*Now, therefore, be it Resolved,* That if the said city of New York shall allow the said strip to be used for the purposes of a public street the village of Freeport will accept the same as such and grade, improve, repair, light, police, and in all respects treat the same as one of the streets of said village; it being expressly understood and agreed that the said city may, when necessary for the purpose of installing, maintaining, or repairing any of its structures used for purposes of water supply, enter exclusively, at any time, upon any part of said strip; that the said city of New York shall complete any work done on said strip in as reasonable time as may be commensurate with the work to be done; the obligation to replace the said strip in condition for use as a street shall be both upon the said city of New York and the village of Freeport, namely, said city of New York shall fill up any excavations that they shall make, and after having done so the said village of Freeport shall put the crown of the road itself in condition for use as a street. The use of said strip by the village of Freeport shall be subordinate to the use of the same by the said city of New York for purposes of water supply.

"*And be it further Resolved,* That in the event above specified the village of Freeport will save harmless the city of New York from any and all causes of action or damages arising or alleged to have arisen by reason of said strip being used as a street as aforesaid except that the said city of New York shall be responsible for any and all causes of action or damages arising out of its own negligence on any part of said strip.

"*And be it further Resolved,* That the village of Freeport reserves any and all rights or causes of actions that it may have against the city of New York to prevent or restrain the said city of New York from interfering in any manner with the Freeport Municipal Water Plant and its water supply, and nothing contained in this resolution shall be construed as an acquiescence by the village of Freeport to any such interference either at the present time or in the future."

By the resolutions passed by the villages of Rockville Center and Freeport, these villages are required to maintain the strip of land to be acquired by the city of New York, as a public road and parkway, subject to the conditions therein contained, if the city will permit the use of such lands for such a purpose. It was evidently the intent of the authorities acting for both parties to make the land to be acquired by the applicant an attractive feature in the park systems of these villages, and do away with any objection that might be raised against the application for fear of a possible nuisance that might spring up in the villages on these acquired lands. The Commission approves of the purpose of the applicant and these villages in this respect, and makes the carrying out of the provisions of these Exhibits "L" and "M" one of the conditions of granting this application.

At the hearing objections were made by the villages of Rockville Center and Freeport to the city of New York acquiring a strip of land running through those villages and adjacent to the line of the Long Island Railroad Company. These objections were based upon the fear that if the city became the owner of such a strip of land, there would be no possibility of locating factories or business plants south of the railroad, because such plants would be denied switching privileges over the land acquired by the city. The question was debated at length. It finally appeared that in the negotiations with the railroad company it was provided that the railroad company should reserve in the deed conveying land to the city of New York, a right to use the surface of such land for railroad purposes. The form of the deed was put in evidence and marked "Exhibit 6" and also letter of Joseph F. Keany, attorney for the railroad, addressed to Josiah A. Stover, Assistant Corporation Counsel, and marked "Exhibit J," stating that the company would execute a deed containing such a clause. The condition is found on page 733 of the stenographer's minutes and reads as follows:

"The party of the first part, its successors or assigns, shall be allowed the use of the surface of the following described lands and premises for railroad purposes not inconsistent with the use of the subsurface thereof by the party of the second part, its successors or assigns, for the purpose of maintaining, preserving and increasing the supply of pure and wholesome water for the use of the city of New York, borough of Brooklyn."

This condition in the deed conveying the land through these villages reserves to the railroad company the right to use the surface of the land, which will permit the crossing of the same by its tracks and switches, and therefore will not be an obstacle in the development of manufacturing or business plants along the line of this railroad. The objections as made by these villages had merit, but the provision permitting the use of the land as provided in the deed removes that objection and the Commission in granting this application makes it a condition that the city of New York shall accept a conveyance of the lands in the form prescribed in said Exhibit "J."

In order to determine and pay any and all damages to persons and property, whether direct or indirect, which will result in the execution of its plans, the city of New York proposes to purchase the desired lands, property and rights and secure releases therefor if an agreement can be reached, but if an agreement cannot be made for such lands, rights and releases, then to secure such lands and rights by condemnation proceedings. This plan does not seem to us to be broad enough to meet the requirements of the statute. A question might arise in an action for damages claimed to be caused by the drying up of a pond or stream, or the lowering of the water table some distance from the actual works of the applicant, or for the destruction of an established business, or loss of employment, all of which causes might be directly or indirectly traceable to the execution of the applicant's plans. In such a case, the applicant here should not be permitted to defeat a just claim for damages, because its petition did not provide a plan or scheme of sufficient breadth or scope to permit the recovery of such a claim. It therefore becomes our duty to make the decision in these proceedings provide a plan for a just determination of such damages and the payment by the applicant of the same. It should in justice to all whose property rights are or may be affected, contain a condition that will protect each person who may be damaged by the execution of the applicant's plans.

The question of damages, both direct and indirect, has been the subject of much discussion in applications of this character. The matter received the careful attention of the Commission in the application of the city of New York to take water from the Catskill mountains. The judgment of the Commission was at that time formulated and enacted into law as chapter 314 of the Laws of 1906, amending section 42 of chapter 724 of the Laws of 1905, and made to apply to the counties of Ulster, Greene and Albany. This law was approved by the city of New York in the Catskill application. So far as the Commission has been advised, it has operated satisfactorily, and we believe its provisions would be just and equitable if made to apply to Nassau county in this application. We, therefore, make it one of the conditions of granting this application that all of the provisions of section 42 of chapter 724 of the Laws of 1905, as amended by chapter 314 of the Laws of 1906, concerning the determination of damages and the recovery of the same in Ulster, Albany and Greene counties shall apply to Nassau county.

We believe the conditions herein imposed make the applicant's plans just and fair to all interests that may be affected and carry out the spirit of the law under which we are acting.

The Commission therefore finds and determines:

(1) That the application of the city of New York, and the plans submitted for a new and additional supply of water for the borough of Brooklyn are justified by public necessity.

(2) That the said plans be and the same are hereby modified as follows:

The city of New York is hereby required to permit any municipality in the county of Nassau to take and receive a supply of water for the uses and purposes of such municipal corporation and its inhabitants from any of the reservoirs, aqueducts, conduits, streams or pipes belonging to the city of New York, located in Nassau county on complying with reasonable rules and regulations and paying for the same a price to be agreed upon, as provided in chapter 350 of the Laws of 1909. It is also required to furnish without compensation to the village of Rockville Center, 750,000 gallons of water per day, or such part thereof as said village may be unable to obtain by a reasonable operation of its municipal plant, if by reason of the execution of the applicant's plans, the amount of water available for said village shall be reduced below 750,000 gallons per day.

The city is also required to furnish without compensation to the village of Freeport, 700,000 gallons of water per day, or such part thereof as said village may be unable to obtain by a reasonable operation of its municipal water plant by reason of the execution of the applicant's plans; and also to deliver water without compensation to such other municipalities in Nassau county similarly situated and similarly affected, as provided in the stipulation of the city of New York, appearing in evidence at page 672 of the stenographer's minutes.

That said plans as herein modified are just and equitable to the other municipalities affected thereby and to the inhabitants thereof particular consideration being given to their present and future necessities for sources of water supply.

(3) That said plans be, and the same are hereby modified as follows:

The applicant shall accept from the Long Island railroad a conveyance of the lands which reserves to the railroad the right to use the surface of such strip of land for railroad and switching purposes, as provided in Exhibit "J," admitted in evidence on the hearing; shall permit the lands running through the villages of Rockville Center and Freeport, mentioned in Exhibits "L" and "M" to be used for highway or park purposes upon said villages complying with the promises in said Exhibits "L" and "M," and shall carry out the promise in the letters appearing on pages 674 to 677. The provisions of section 42, of chapter 724, of the Laws of 1905, as amended by chapter 314 of the Laws of 1906, as the same applies to the determination and payment of damages in the counties of Ulster, Greene and Albany shall apply to Nassau county.

That said plans as so modified make fair and equitable provisions for the determination and payment of any and all damages to persons or property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve said application of the city of New York, with the modifications in said plans submitted, as hereinbefore stated and set forth, which modification it deems necessary to protect the water supply interests of the municipal corporations and civil divisions of the State in Nassau county, and the rights and property interests of the inhabitants thereof that might be affected thereby.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has made the foregoing decision in writing, signed the same, and caused [L. S.] its official seal to be affixed hereto, and the same together with all plans, maps and surveys and other papers or records thereto, and the testimony taken by it, filed in this office, in the city of Albany, this 15th day of May, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 51.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the VILLAGE OF BAINBRIDGE.
} *Decision.*

Application filed, March 16, 1909.

Hearings, at Bainbridge, May 19, June 24, August 18, 1909.

Decision, August 18, 1909.

Bainbridge is an incorporated village situate on the west bank of the Susquehanna river, in the town of Bainbridge, Chenango county. It has a population of 1,180. The assessed value of the real and personal property of the village, as appears from the assessment-roll of 1908, was $536,200; there is a bonded indebtedness of $26,750, which amount includes $22,750, issued for the acquisition, at a foreclosure sale, of its present water supply system. This is a gravity supply, the sources being the Newton and Yaleville creeks, upon both of which are small intakes. The distributing lines are laid in all the village streets, and on these the fire hydrants appear to be well located.

The water supplied is in general use for all purposes by the inhabitants of the village. The gross annual revenue is about $3,300 per annum, of which amount about one-quarter is paid by the Delaware and Hudson Railroad Company for an unlimited use of the water for railroad purposes.

The development on the Newton creek consists of a small stone concrete dam across the creek, with a stone wall laid up loose at right angles to the dam, forming a small well or compartment from which the water is taken by a pipe and carried down stream some 600 feet to a small well from which it is conducted into a reservoir of about 150,000 gallons capacity, situate at an elevation of 165 feet above the village.

Upon the Yaleville creek there is only a small intake or well, at an elevation of about ninety feet above the corner of West and North Main streets. in the village, from which the water flows directly into the distributing system. Necessarily, this development proved grossly inadequate for all the needs of the community and for the railroad; and the small reserve for fire protection that was alone furnished by the Newton creek reservoir was a menace rather than a protection.

A witness upon the hearing said: "The duration of the season upon which the Newton creek supply can be relied upon varies from year to year. Some seasons it can be used to supply the wants of the village up to June 15th. * * * June 15th is a fair average."

With regard to the Yaleville supply the same witness said: "The Yaleville creek source in ordinary seasons supplies that part of the village which it will reach up to about the middle of August. It depends upon the amount of rainfall during the months of August and September, and some seasons when there is rainfall in August it went through the month of September. * * * I believe there has been one season since it was installed that there was water from this source throughout the entire season."

When the system did not furnish sufficient water the village arranged with the National Milk Sugar Company to pump water from its deep wells, situate in the village and near the Susquqehanna river, into the village distributing system, but this addition to the supply was only a makeshift and could not be relied upon permanently.

To overcome these defects in its water supply system the village proposed at first to go about 1,800 feet above its present intake on the Yaleville creek, and there at an increased elevation of about thirty feet over the present intake construct a small dam and intake at a cost of about $5,000, exclusive of land damages.

The village engineer, testifying in relation to this proposed new work said, in substance, that in no sense would it furnish fire protection nor would the supply without storage be adequate, and whenever a dry period occurred resort would necessarily have to be had to the pumps — and he could not recommend the proposed plan. The water supplied by the present system is not filtered and sources of pollution were shown.

From this review it is apparent that this proposed plan of the village of Bainbridge to increase its water supply was not justified by public necessity, and this Commission for that reason, up to this time, withheld its approval, even though the electors of the village had given it their approval by a divided vote.

Thereafter, and on July 22, 1909, two further additional propositions were submitted to the electors, viz: (1) A proposition to extend, improve and supplement the present supply by the establishment, installation and equipment of deep wells and a suitable and adequate pumping station at a cost not to exceed $4,000, and (2) a proposition to construct and install a filtration plant for the purpose of rendering sanitary and wholesome, for domestic purposes, the water supplied to the inhabitants of the village at an expense not exceeding $2,000.

Both of these propositions were adopted, the first by an affirmative vote of seventy-seven to twenty-one opposed, and the second by an affirmative vote of ninety-five to three opposed. The proposition to construct the wells involves the acquisition of real property.

The application to this Commission, as now finally submitted, is substantially as follows:

To maintain the present system, to erect on the Yaleville creek a new dam of about six feet in height, at an elevation of thirty feet above the present intake, making an increased storage of 400,000 gallons, to construct a filter at that point, and to rely upon the seventy gallons per minute which can there be obtained for domestic purposes, and when that quantity was insufficient to pump the additional supply from deep wells which are to be constructed on the west bank of the Susquehanna river and within the village limits, the pumping capacity of which will be 350 gallons per minute. There is no doubt that there will be times when the gravity source of supply will be inadequate and that without storage resource must be had to the proposed pumping plant; and from past experience as to that source of supply there appears to be no doubt but that an adequate supply for all purposes can be had.

Other plans furnishing a full supply by gravity and involving a total expenditure of $20,000 in one instance and of $35,000 in another were suggested, and while either of these would be preferable to the proposed project, the clearly expressed wishes of the taxable inhabitants should control whenever the proposed plans produce a necessary supply at a decreased present cost. Any substantial increase in water consumption in the future will necessarily and in the interest of economy require the installation of further storage.

No other municipality or civil division of the State is affected by the plans of the village of Bainbridge and no question has been raised as to the plan of the applicant to provide payment and compensation for damages.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the village of Bainbridge are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the village of Bainbridge for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed thereto and the same, with all the maps, surveys and other papers relating thereto filed in its office in the city of Albany, this 18th day of August, 1909.

[L. S.]

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 53.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF WEST CARTHAGE, Jefferson county, N. Y., for approval of plans for securing a new and additional Supply of water.

Decision.

Application filed: April 7, 1909.

Hearing: April 22, 1909.

Decided: April 22, 1909.

The village of West Carthage, with a population of about sixteen hundred and duly incorporated under the Village Law, on April 7, 1909, made an application to this Commission for permission to acquire and construct a new and additional water supply system.

At the present time the village obtains its water supply from the village of Carthage under a contract dated October 5, 1895. This contract provides for the payment by the village of West Carthage to the village of Carthage of five hundred dollars ($500) per year for the water it consumes. A short time ago the village of Carthage served a notice upon the village of West Carthage that the agreement mentioned in the contract of October 5, 1895, would be no longer in force. The village of West Carthage instituted proceedings and obtained an injunction prohibiting the village of Carthage from turning the water off from the mains and distributing system of West Carthage. That injunction is still in force.

The village of Carthage offers to continue to furnish water to the village of West Carthage for $25 per year for each of the fifty-four hydrants, and five cents per thousand gallons for all water used, except the water used in case of fires. The officers of the village of West Carthage estimate that under such a contract it would cost them from forty-three to forty-six hundred dollars per year for water. The village of Carthage also offers to furnish the village of West Carthage with water and charge the same prices that are charged in the village of Carthage. Each of these offers recites that the village of Carthage may terminate the arrangement on six months' notice, which it seems to the Commission, does not give the village of West Carthage sufficient time to install a new water plant.

The proposed new system of the village of West Carthage for taking water from Vrooman spring into a standpipe about three-quarters of a mile from the springs and about two miles and a quarter from the village will cost, including land damages, standpipe and laying pipes, about thirty thousand dollars ($30,000). It will be a gravity system. and therefore the expense of maintenance and operation will be nominal. The village by a vote of 136 in favor, and 6 or 8 against, have voted to bond the village for $30,000 for the purpose of installing this proposed plant. The interest upon the bonded indebtedness at 4 per cent. would be $1,200 per year, thus making a saving by installing the proposed system as compared with the terms of the village of Carthage of at least $3,100, a sum that would retire the bonds in ten years.

The village of West Carthage offers to pay all damages, both direct and indirect, that may arise by reason of the execution of the proposed plans, and it also agrees not to object to the reception of evidence showing indirect damages in any action that may be brought to determine such damages.

There is no other municipality or other municipal division of the State that will be affected by establishing or installing the proposed water plant, and the plans are just and fair to all other municipalities and civil divisions of the State.

Although objections had been filed they were not pressed at the hearing, and having been based upon property interests in lands to be acquired, are overcome in effect by the stipulation of the village as to damages which may be caused.

The advantages to be obtained by the village of West Carthage in installing this proposed water system are many; and the Commission therefore finds and determines, on account of the notice served by the village of Carthage and the demands made upon it, that a public necessity exists.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the village of West Carthage are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof,

particular consideration being given to their present and future necessities for sources of water supply.

(3) That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps of the lands to be acquired by the village of West Carthage for a new or additional source of water supply and the profiles thereof showing the sites and areas of the proposed reservoirs and other works, the profiles of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys and abstract of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto and the same with all plans, maps, surveys and other papers relating thereto filed in the office at the city of Albany this 7th day of April, 1909.

[L. S.]

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 54.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the RENSSELAER WATER COMPANY.

Decision.

On the 12th day of April, 1909, the Rensselaer Water Company filed its application with the Commission for authority to build and construct a storage reservoir on Robbins Hill near the city of Rensselaer for the purpose of increasing and improving the water supply for the city of Rensselaer and the other customers of the company.

The Rensselaer Water Company is a domestic corporation organized under the laws of the State of New York, and has been engaged, since its organization, in furnishing potable water to the city of Rensselaer, certain railroads, and the village of Bath-on-the-Hudson. Water is taken from the Hudson river, and after filtration, is pumped into a standpipe near the corner of

Catherine and Third streets, holding about 300,000 gallons of water. The elevation of this standpipe does not afford sufficient pressure to properly protect the city in times of fire; this is especially so at the higher points of the city. Complaints have been made by the citizens of the city of Rensselaer as to the amount of fire protection which the present system provides, and they have asked the applicant to increase its storage and also increase the elevation of its standpipe.

Acting upon the suggestions and requests of the citizens of Rensselaer, the company proposes to abandon its present standpipe and construct a new reservoir on Robbins Hill that will hold five and one-half million gallons of water at an elevation of sixty feet above the present standpipe. This will afford fire protection of at least forty-five pounds pressure in the highest parts of the city and from one hundred to one hundred and five pounds pressure in the business portion of the city, and will store a sufficient quantity of water for three days' supply. The water will be pumped from the filtration plant into this reservoir by three pumps which are already installed at the pumping station. No water from any stream whatever except the Hudson is taken in the proposed plans. The building of the proposed reservoir will not interfere with the present or prospective water supply of any other municipal division of the State.

The income of the company is sufficient to pay any and all damages to persons or property, either direct or indirect, that may be taken or injured in the building of this proposed storage reservoir.

The present plans of the company in filtering its water makes it a safe, potable water, and moreover, constant improvements are being made in the filtration plant.

The Commission is of the opinion, therefore, that the application is in the interest of the consumers of water in the city of Rensselaer and should be granted.

The State Water Supply Commission therefore determines:

(1) That the said plans of the Rensselaer Water Company are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to the present and future necessities for source of water supply.

(3) That such plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of such plans.

The application of the Rensselaer Water Company for permission to construct an addition to its water supply system, as stated in its application, is hereby approved.

WITNESS our hands and official seal of the State Water Supply Commission this 21st day of April, 1909.
[L. S.]

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 55.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the CITY OF NIAGARA FALLS for the approval of its maps, plans and profiles for a new and additional water supply.
} *Decision.*

Filed: April 20, 1909.

Hearing: April 30, 1909.

Decided: June 15, 1909.

Modified: July 14, 1909.

The city of Niagara Falls comes here for the approval of its maps, plans and profiles for a new and additional source of water supply.

A hearing was had thereon at the Common Council Chamber in the city of Niagara Falls on the 30th day of April, 1909. The city and its Board of Water Commissioners was represented by Anthony C. Douglas, mayor of the city and chairman of the Board of Water Commissioners; James F. Murphy, George W. Whitehead, Martin T. Ryan, A. J. Porter and Walter McCulloh, members of the Board of Water Commissioners; William D. Robbins, city engineer, and by Franklin J. Mackenna, corporation counsel.

Due proof of publication of the notice of the hearing was produced and filed.

No objections to the application were filed and no one appeared in opposition to the plans of the city.

The Board of Water Commissioners of the city of Niagara Falls was created and its duties defined by chapter 145 of the Laws of 1908.

At the present time the city of Niagara Falls is supplied with water from two sources, one a municipal plant and the other a private one. The municipal plant supplies the northern part of the city and takes its water from the canal of the Niagara Falls Hydraulic Power and Manufacturing Company, which canal is fed from the American shore of the Niagara river. The private water company furnishes the southern portion of the city and takes its supply from the canal of the Niagara Falls Power Company, which canal is also fed from the American shore of the Niagara river. The water furnished by both of these plants is delivered through their distributing mains to the consumers by direct pumping pressure.

Analysis of many samples of the water from both of these sources show that in each case it is contaminated with sewage. The health officer of the city, Dr. Jeruld, stated that typhoid fever has been extremely prevalent in the city especially during the past four years, over 100 cases being reported in a single year, which was probably not more than one-half of the actual number of typhoid cases during that period. Such a condition produced by the impure water supply of the city is sufficient to call for active measures on the part of the Board of Water Commissioners.

The city proposes to construct a timber and concrete crib about 25x100 feet with a steel nose at a point in the Niagara river about 1,500 feet from the American shore, and to lay therefrom a 48-inch steel intake pipe to a pumping station and filtration beds, and connect this pumping station with the distributing mains of the city plant and the distributing mains of the Niagara Falls Water Works Company. The plans have been so prepared that the capacity of the plant in the future can be increased from 15,000,000 gallons to 30,000,000 gallons per day. The pumping station and filtration beds are to be erected upon land to be taken by purchase or condemnation. The total cost of the proposed system is estimated at $717,000. The plan and prospectus, together with an estimate of the cost, were submitted to a vote of the people of the city, and an election duly held on the 10th day of March, 1909, at which time 1,654 votes were cast, with 1,366 for the proposition and only 278 against it.

The city, in paragraph twelve of its petition states that its " plan or scheme to determine and provide for the payment of proper compensation for any and all damages to persons or property, for either direct or indirect damages which will result from acquiring any of the lands needed, and the execution of said plans is to purchase the same, and secure conveyances and releases thereof, if the amount can be agreed upon, and if not, to acquire the same by condemnation proceedings, as provided by the Code of Civil Procedure."

There is involved in the city's application the question of what effect, if any, the execution of its plans will have upon the property of the Niagara Falls Water Works Company, The provisions of the statute which require this Commission to see that the plans of the city of Niagara Falls provides a proper scheme for the payment of any and all damages, both direct and indirect, which will result from the execution of its plans, is intended, first, to prevent the ruthless destruction of property by a municipality, and second, to permit a municipality to provide for itself an ample supply of pure and wholesome water without being compelled to purchase such water from a private company or submit to extortionate rates or unfair conditions. It is possible, in most, if not in all cases, for the owners of a private water system to agree with the municipality upon a fair price at which the municipality may take over the property of the private company and make it a part of the municipal plant. The Code of Civil Procedure provides a way for municipalities to acquire such property where an agreement between the parties cannot be reached. As we interpret the statute and understand the meaning of the plan of the applicant as proposed in paragraph twelve of its petition, it is a fair way of determining and paying all damages, both direct and indirect, that may result in the execution of the applicant's plan.

It was shown on the hearing that the sewers of the city of Buffalo discharge into Niagara river along the American shore at a point about eighteen miles above the intakes of the canals at Niagara Falls from which the supply of drinking water for the city is taken. This fact, together with the analysis of the samples of the river water and the high rate of typhoid fever prevalent in the city, authorizes the finding that this application is justified by public necessity.

The proof shows that taking the water in the manner proposed by the city of Niagara Falls will not in any way interfere with any other municipality or civil division of the State.

The population of the city of Niagara Falls is about 27,000. Its assessed valuation is $23,404,760, and the present bonded indebtedness is $1,511,919, showing that it is abundantly able to install the new plant without financial burden to the people. The vote of the city by so large a majority in favor of the proposition is ample evidence that the people are interested in a new and better source of water supply.

These facts justify the Commission in approving the plans of the city.

There is one consideration, however, that the Commission deems it wise to call particular attention to, namely, the question of extending the intake main farther out into the Niagara river to a point in the Canadian channel where, as shown by the documentary proof submitted to the Commission, a purer supply of water can be had. We feel justified in calling the attention of the city of Niagara Falls to the advisability of seriously considering the building of this intake at such a point in or near the Canadian channel as will, in connection with filtration, protect it, as far as possible, from an infected water supply.

The question for the city to consider is whether it is ever safe, in a matter of supplying potable water, to stop inside of the very safest point. We believe that the city of Niagara Falls would be more than justified in carrying its intake pipe farther out from the American shore to remove, as far as its situation will permit, all possible doubt as to the purity of the water from this source.

The Commission does not feel, however, that it would be justified in withholding its approval of the plans submitted by the city, because the city has not gone to the very safest point for its water supply, inasmuch as its plans provide for sand filtration. The plans of the city for taking water from the point in the river where it proposes to take it, together with the contemplated filtration system, will provide a reasonably safe supply.

The Commission, therefore, finds and determines:

(1) That the plans of the city of Niagara Falls for a new and additional source of water supply are justified by public necessity.

(2) That such plans are just and equitable to the other municipal and civil divisions of the State, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of such plans.

The application of the city of Niagara Falls for permission to build and maintain a new municipal plant, according to the plans and specifications filed with this Commission, is hereby approved.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has made the foregoing decision in writing, signed the same, and caused its [L. S.] official seal to be affixed hereto, and the same, together with all plans, maps and surveys and other papers or records thereto, and the testimony taken by it, filed in this office in the city of Albany, this 14th day of July, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 56.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF WEBSTER, for the Approval of its Amended Maps and Plans of Proposed Water Works System.

Decision.

Application filed, May 5, 1909.

Hearing at village of Webster, May 13, 1909.

Decision, June 15, 1909.

John W. Barrett, Esq., for village of Webster, applicant.

John Van Voorhis' Sons (Eugene Van Voorhis, Esq.), for Joseph Zimmer, an objector.

The village of Webster filed an application with the State Water Supply Commission, November 23, 1908, for the approval of its maps, plans and profiles for a new and additional source of water supply. Public notice was thereafter given by the Commission that on the 12th day of December, 1908, the Commission would meet at the village of Webster for the purpose of hearing all persons, municipal corporations, or other civil divisions of the State that might be affected by that application. and on the day specified in the notice the Commission met at the place named in the notice and proceeded to examine the maps and profiles and hear the proofs and arguments submitted in support and in opposition to the proposed project of the village: upon that hearing, Joseph M. Zimmer, the objector, with others, appeared. having filed objections prior to the day of the hearing. Following the hearing the Commission determined that the plans proposed by the village of Webster were justified by public necessity, that they were just and equitable to other municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and that the plans of the village of Webster as modified upon the hearing made fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which would result from the execution of said plans. This decision of the Commission, together with the plans, maps, surveys and other papers or records relating thereto, was filed on the 12th day of December, 1908.

The applicant upon that proceeding now comes before this Commission and files a further application relative to the same subject-matter, as the application of November 23, 1908, viz.: A water supply for the village of Webster. In this new petition the village states that after the making of the determination by this Commission, on December 12, 1908, it amended its map and plans upon two occasions, to wit: February 18, 1909, and March 1, 1909, and in the following particulars: The first amendment being for the purpose only of making the description of the lands to be taken for the said proposed water works system more definite and certain, and the second amendment for the purpose of correcting an error in the description of the lands to be taken from one particular land owner, and the substitution of one style of pipe for another. This petition further recites that the amendments to the maps were solely for the purpose of making the same more definite and detailed; that it in no way changed the sources of water supply, the lands, streams, water, water rights, right of way or easements, theretofore determined to be acquired by the applicant for its system of water works, as embraced in the application of November 23, 1908, and approved by this Commission in its determination of December 12, 1908, and accordingly asks the approval of the amended maps which were submitted with the petition.

This application was filed May 5, 1909, and thereupon the Commission gave the usual statutory notice of hearing, as provided by section 3 of chapter 415 of the Laws of 1906. In response, Mr. Joseph Zimmer filed the objections: (1) That the plans proposed are not justified by public necessity; (2) that the plans proposed are not just and equitable to the inhabitants of the town of Penfield affected thereby, including the objector; (3) that the plans proposed do not make fair and equitable provisions for the determination and payment of any and all damages, both direct and indirect, to persons and property, and in particular to the property of the objector, which will result from the execution of said plans. He also makes two further objections which are specifically in support of the other objections named.

Upon the hearing held at the village of Webster, on May 13, 1909, it was shown to the Commission that the village had not been able to agree with certain property owners as to the price to be paid for the proposed right of way, and that before condemnation proceedings were instituted the maps had been amended by the village in the details hereinbefore mentioned, and that objections were interposed to the condemnation proceedings thereafter instituted chiefly upon the ground that the amended maps had not been approved by this Commission. The court before which the petition in condemnation was pending, in rendering a decision upon the motion to dismiss the proceedings, said:

"The intent and meaning of section 2 of the State Water Commission Act is, that before any condemnation proceedings can lie, the maps and plans as finally completed, under which the municipality intends to act, must be submitted to and approved by the State Water Commission; any other construction would nullify the acts. Otherwise, any village might prepare maps and plans satisfactory to the Commission, procure its approval, and thereafter change them in such material particulars and in such manner that, if originally presented, would have constrained the Commission to withhold its approval.

"I do not overlook the statement that the changes made by plaintiff in its maps and plans have in no way changed them except to make certain descriptions more definite and certain.

"This may be so but, at best, it is a matter of opinion and construction; if the plaintiff in these cases is to be allowed to change maps and plans after approval, so as to make them more definite and certain, the burden would rest upon the court in each instance to examine the original and the amended maps and plans, and determine whether the judgment of the plaintiff as to the course and scope of the amendment was correct.

"The intent of the two statutes read together is that all maps and plans, whether original or as changed and amended, shall be approved by the State Water Commission as a condition precedent to the institution of condemnation proceedings. Without this the court has no jurisdiction to grant the relief sought.

"Petition is dismissed and motion denied."

Following which the present application was filed.

The testimony given on the hearing by the witnesses sworn on behalf of the applicant establishes the fact that one amendment of the map originally filed with this Commission was for the purpose of showing a correct boundary line between two adjoining owners, and the other amendment was a map drawn on a larger scale, showing the boundaries of the right of way for the pipe line and some courses and distances marked which were not shown on the original map. There is no change in the course or direction of the right of way, or in the source of water supply, and other than the correction of the mistaken boundary line all the information conveyed by the amended maps could have been found upon those originally filed and approved.

These amendments are not material and have not changed the scope and plan of the village of Webster for its water supply system. If they had been shown upon the first maps filed no other or different determination by this Commission could have been had.

The objector, Zimmer, has had his day in court upon the application of the village of Webster for a source of water supply. The objections he made and filed were considered and the application modified to meet them. It cannot now be said that if what are named as "amendments" to the maps had been shown upon the maps first filed his objection would have been different or have in any way further modified the proposed plans, much less have been of sufficient importance to have produced a different determination than that of December 12, 1908.

The evidence further shows that the applicant does not desire to take, acquire or condemn lands other than those for which approval has already been given. No new or additional source of water supply is asked for. The sites and areas of its proposed reservoirs or other works, the profiles of the aqueduct lines, the flow lines of the water when impounded, plans and surveys, remain substantially as already approved, as well as the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans. The very slight and immaterial changes that have been made in the maps and plans, where any have been made, are such as are incidental to the construction of all water supply systems.

The Commission, therefore, approves the amended maps and plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has made the foregoing decision in writing, signed the same, and caused its [L. S.] official seal to be affixed hereto, and the same together with all plans, maps and surveys and other papers or records thereto, and the testimony taken by it, filed in this office in the city of Albany, this 15th day of June, 1909.

HENRY H. PERSONS.
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 57.

VILLAGE OF CANAJOHARIE.

(Pending.)

APPLICATION NO. 58.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter of The Application of the VILLAGE OF CROGHAN, for the Approval of its Maps, Plans and Profiles for a New and Additional Source of Water Supply.	*Decision.*

Application filed, June 17, 1909.

Hearings at the village of Croghan, July 2 and July 21, 1909.

Decision, September 22, 1909.

The village of Croghan is situate on the Beaver river, in the county of Lewis, and has now an estimated population of 650. It was incorporated in 1906. There are in the village 128 dwellings, 32 of which are without a water supply. There are also several manufacturing enterprises, hotels, churches, schools, stores and other business places, in all about 165 buildings, not including barns and outbuildings. There is no municipal sewer system, though there are several private drains and sewers now in use. There is no fire protection furnished to the village and its inhabitants except by means of a hand engine and five underground wells or cisterns. The latter, during drought and a portion of the summer season, often become dry and are of no service, as was shown by two disastrous fires. Nor is there a means of supply for domestic purposes except from 96 house wells, many of which also become dry during the summer season and in time of drought.

At the annual village election held on the 16th day of March, 1909, the electors, by vote of 78 in the affirmative to 51 in the negative, adopted a proposition to install a water works system for the village at a cost not to exceed $29,000, following which, the village authorities, as shown by plans and the application filed in this matter, proposed to take a gravity supply from springs situate about four and three-quarters miles from the village, within the town of Croghan, and to construct at the springs a reservoir of 2,000,000 gallons capacity, which is to be built of cement, large stones and concrete upon a natural rock foundation, with gatehouse and necessary accessories for the proper management and regulation of the water. From the reservoir the water will be conducted to the distributing system in the village.

The proposed system includes the following general features: Three thousand feet of 12-inch pipe, 1,000 feet of 10-inch pipe, 9,000 feet of 8-inch pipe, 14,550 feet of 6-inch pipe, 407 feet of 4-inch pipe, 22 two-way hydrants, 18 gates or valves, specials and other accessories for completing the system.

From the springs an adequate supply of water for municipal purposes, for fire protection and domestic use can be obtained, the flow from the springs being sufficient, at the present time, for a village of at least three times the size of Croghan. The water is soft and will be suitable for all household purposes, including drinking, if the contemplated plans of the village are fully carried out to protect the supply and the watershed from pollution.

The assessed valuation of the property within the village, as shown by the last assessment-roll, is $93,000, which amount is conceded to be about one-fifth of the actual value. There is no bonded or other indebtedness outstanding against the village.

Several objections were filed to the proposed plan and testimony was given showing that the village could secure an adequate water supply for fire protection, at a cost of not to exceed $14,735, by installing a pumping station on the Beaver river, and pumping the river water directly into the mains. While it is true that a system of this kind could be established at a lower first cost, the annual maintenance charge will be as great or greater than the interest charge on the proposed gravity system. In addition, there is the disputed question of the purity and acceptability of the Beaver river water, if it were to be used for domestic purposes. There was no evidence given to show that an adequate gravity supply could be secured at some point nearer the village than the one proposed, and it clearly appeared upon the hearing and from the testimony given that the plan contemplated in the application will prove the best and most economical system for the village to construct.

The waters of the springs proposed to be taken by the applicant flow into Murmur creek, a branch of the Beaver river, which is tributary to the Black river, the latter finding its outlet in Lake Ontario and within the watershed of the springs and the Murmur creek, there is no other municipal corporation or civil division of the State affected by the application, nor are these waters available to any other municipal corporation or civil division of the State.

The State Water Supply Commission, therefore, determines:

(1) That the plans proposed by the village of Croghan are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the village of Croghan for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office, in the city of Albany, this 22d day of September, 1909.

[L. S.]

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 59.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the VILLAGE OF MECHANICVILLE for the Approval of its Maps, Plans and Profiles, for a new and additional source of water supply.
Decision.

Application filed, June 22, 1909.

Hearing, July 13, 1909.

Decision, July 13, 1909.

The village of Mechanicville, on the 22d day of June, filed its petition, asking for the approval of its maps, plans and profiles for a new and additional source of water supply for that village.

After due notice the matter came on for a hearing at the La Dow Steamer Hose Company's rooms, in said village, on the 13th day of July, 1909. Due proof of the publication of the notice for such hearing was filed with the Commission and Robert W. Fisher, attorney for the board of trustees of the village of Mechanicville; Robert N. Patrick, president; John O'Brien, Homer Eckerson, George Slingerland and Dennis Flannagan, members of the board of trustees of such village, appeared for the applicant. No objections were filed to the petition and no one appeared in opposition.

The evidence given upon the hearing shows that this village has a population of nearly 7,000 people, and has within its limits property assessed for over $2,000,000. It is a thrifty, industrial community, and has within its jurisdicdiction many prospering manufacturing industries. The village owns its present plants and takes its water from Plum creek at a point about three miles distant from the village and about eighty-five feet above it. There are outstanding $123,000 in water bonds. The entire system is metered and produces a gross income of about $14,000, nearly one-half of which is paid by business corporations located in the village and by railroad companies. The other half of the income is derived from house and domestic service. The net income of the system after paying all fixed charges, including the interest on its bonded indebtedness and cost of maintenance, is about $5,000. The present plant furnishes a sufficient quantity of water and the needed fire pressure during the winter time and in seasons of abundant rainfall only, but during the dry summer months there is a shortage of water, and on account of the nature of the ground in and above the present reservoir the water becomes colored and has a disagreeable odor which makes it very objectionable for domestic use. On account of this shortage of water and its objectionable condition the village is compelled to install a temporary pumping station in order to supply the demand for domestic use, and to maintain a sufficient fire pressure. The fact that nearly one-half of the entire income is derived from the sale of water to corporations and railroad companies should be considered in passing upon this application. From these sources the net income can plainly be traced. At the present rate, if the $5,000 surplus should be placed in a sinking fund each year, it would be only a few years before it would pay off the present bonded indebtedness and also the cost of making the improvements asked for in this application. It appears, therefore, that the proposed plan for increasing the water supply in this village is justified by public necessity.

The village. in its application, proposes to build a new reservoir on Plum brook below the present reservoir site and below its confluence with Baker brook, and at a point where abundance of water can be had at all times of the year, furnishing ample fire protection. A permanent pumping station and filtration beds are to be installed, all of which is shown upon maps and plans accompanying the application. This can be done at an expense of not to exceed $12,000.

The proof also shows that no other municipality or civil division of the State will be affected by the execution of the applicant's plans, particular consideration being given to their present and future necessities for sources of water supply.

The village has voted in favor of the proposition to issue $12,000 in bonds to be used in making the additions to the water plant as proposed in the applicant's application. With this the village also says that it will pay any and all damages to persons or property, both direct and indirect, which will result from the execution of such plans, and if an agreement cannot be reached as to the amount of such damages, the village will condemn such property in the manner provided by the Code of Civil Procedure. This is a fair and equitable provision for the determination and payment of such damages.

The State Water Supply Commission, therefore, determines:

(1) That the plans proposed are justified by public necessity.

(2) That the same are just and equitable to the municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That such plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of such plans.

The application is, therefore, approved.

[L. S.] IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has made and signed this decision and caused its official seal to be affixed hereto, and has filed the same, together with all maps, plans, surveys, and other papers or records relating thereto in its office, this 20th day of July, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 60.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the CENTRAL BRIDGE WATER COMPANY for the approval of its maps and profiles for a new and additional water supply.
} *Decision.*

Application filed, July 14, 1909.

Hearing at Central Bridge, July 29, 1909.

Decision, July 29, 1909.

The applicant is a domestic water company organized in 1895, since which time it has owned and operated a gravity supply in the Hudson River watershed, Schoharie Creek subdivision, at Central Bridge, Schoharie county. It furnishes water for domestic purposes to the inhabitants of Central Bridge (unincorporated) for fire protection to the fire district there established and to the Delaware & Hudson railroad for railroad purposes at that point.

The capital stock of the company is $25,000. There is no corporate indebtedness. All the officers and a large majority of the stockholders of the company reside in the locality.

The source of the supply is the Scott brook, which is about one mile and a quarter long, and flows into the Cobleskill creek, a tributary of the Schoharie. Upon the brook and about one and one-quarter miles from Central Bridge, the company has constructed a reservoir of about 30,000,000 gallons capacity, from which a 6-inch cast-iron pipe line conducts the water to its distributing system at Central Bridge.

The fire district has an assessed valuation of $43,000; within its limits there are about 200 inhabitants, about 50 residences, several stores, 3 hotels, a number of factories and a railroad and milk station. Nearly all of these structures are connected with the distributing system upon which are located nine fire hydrants at suitable places, for each of which the fire district pays $25 per annum. The system proved adequate until the summer of 1908, when for nearly two months there was a complete failure of supply.

This application is for the purpose of acquiring about fifteen acres of land upon the Scott brook upon which an additional storage reservoir is to be constructed for the purpose of securing a reserve supply for periods of drought. The new reservoir will be located 200 feet above the present intake and about one-quarter of a mile up stream from the present reservoir. It will have a water surface when full of approximately eleven and one-half acres with a depth of ten feet of water at the pipe outlet. Scott brook is fed principally by springs. The watershed above the present intake is about one square mile in extent, is flat, and of chiefly farming lands. From the fact that until 1908, which was a very dry year, the supply was sufficient, it would appear that the stream is capable of furnishing sufficient water for the company's needs, providing the proposed storage capacity is sufficient to hold the waters which heretofore have run to waste.

More than doubling the present storage capacity will undoubtedly give the company all the water it needs for the present. The waters of Scott brook are not available to any other municipal corporation or civil division of the State, nor are these affected by the proposed plans of the applicant.

The company has the financial ability to pay $2,500, the estimated cost of its new work, and to comply with the plans submitted by it for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the lands or the execution of its plans.

Chemical and bacteriological examinations of the waters proposed to be taken show that the water is of excellent quality, fairly soft and is suitable for use for all purposes of the household, including drinking.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the Central Bridge Water Company are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the Central Bridge Water Company for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

[L. S.] IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany this 29th day of July, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 61.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the WHITNEY'S POINT WATER COMPANY for the approval of its maps and profiles for a new and additional water supply.
} *Decision.*

Application filed: July 8, 1909.

Hearing at the village of Whitney's Point: July 30, 1909.

Decision: July 30, 1909.

In 1902, and after a disastrous fire in the village of Whitney's Point, the Whitney's Point Water Company, the applicant, was organized under the laws of the State of New York for the purpose of supplying water to the inhabitants of that village. The company constructed a gravity water system, taking its supply from springs situate in the town of Lisle, Broome county, about three miles north of the village. From these springs the water is conducted in cast-iron mains through the village of Lisle and Whitney's Point to a reservoir having a capacity of 850,000 gallons and situate about three-quarters of a mile from the northerly limits of the laterly village. The mains are four and six inches in diameter; 4-inch distributing pipes are laid in all of the streets in Whitney's Point, to which are attached twenty fire hydrants.

In 1902 the company entered into a contract with the village of Whitney's Point to supply it with water for extinguishing fires and other municipal purposes for a term of five years, the village agreeing to pay the company

$30 per year for each hydrant. This contract was renewed in 1907 for a further period of five years. At the present time the water company is supplying a few of the inhabitants of Lisle from the main which runs through that village, about 60 per cent. of the inhabitants of Whitney's Point, and is also furnishing water to the Delaware, Lackawanna & Western railroad at Whitney's Point for railroad purposes. After these are supplied the surplus water only of the system flows by gravity into the reservoir upon which the village must chiefly depend for its fire protection.

While no objections have ever been made to the quality of the water supplied by the company, yet the village authorities have made objection to the small quantity of water stored in the reservoir, alleging that there was not sufficient water there at all times to furnish necessary fire protection, and that the supply of water to the system was inadequate to maintain that required supply. To meet these well taken and accepted objections, the petitioner makes this application to obtain a new and additional source of water supply. By its plans now filed with this Commission, it proposes to increase its present supply by taking the waters of a number of springs situate in the town of Lisle and upon a separate watershed from its present source of supply and conducting the water there collected through a 4-inch cast-iron pipe to its main pipe line at a point between the villages of Lisle and Whitney's Point. The elevation of these springs is much greater than that of the reservoir. The water is suitable for domestic purposes and the quantity of water that can be obtained will keep the reservoir full, thus maintaining a constant pressure of sixty pounds for fire protection and overcome the recognized objections to the water system of the applicant.

The cost of the new work and the acquiring of the new sources of supply is estimated at $2,500. The capital stock of the company is $20,000, and its total indebtedness $25,000. The village of Whitney's Point has a population of 749 (enumeration of 1905), and an assessed valuation of $281,795 (assessment of 1908). It is situate in the town of Triangle, Broome county, and lies on the westerly side of the Tioughnioga river near its junction with the Otselic in the Susquehanna watershed, Chenango subdivision. The municipality does not own its water supply, and other than from private wells, the only source of supply of its inhabitants is from the water furnished by the applicant, and from the testimony taken on the hearing it would appear that the water company has practically the only available supplies in the vicinity. The waters of the Tioughnioga and Otselic are contaminated by sewage and are not here suitable for domestic purposes. There are no municipalities or other civil divisions within the watersheds of the springs proposed to be taken and their waters are neither available for other communities, except the village of Lisle, which has a population of 378 (enumeration of 1905), and through which the mains of the applicant extend, nor are they now being used for any purpose whatever. No objections were filed to the application of the petitioner, and upon the hearing no person appeared in opposition. The applicant omitted to file with its petition a plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, that would result from the acquiring of the proposed lands and the execution of its plans. Upon the hearing it supplied the omission and it was there also shown that the water company had the ability to procure the money necessary to carry out the proposed plan.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the Whitney's Point Water Company are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans, as modified, make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the Whitney's Point Water Company for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

[L. S.] IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany this 30th day of July, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 62.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the WATER COMMISSIONERS OF THE WATER DISTRICT OF THE TOWN OF PETERSBURG, Rensselaer county, N. Y., for the approval of its maps and profiles for a new and additional water supply. } *Decision.*

Application filed: July 15, 1909.

Hearing at Petersburg: August 6, 1909.

Decision: October 14, 1909.

This is an application by the Water Commissioners of the Water District established June 29, 1909, in the town of Petersburg, Rensselaer county, for the approval of its maps and profiles for a water supply for that district. The water district embraces within its limits the closely-built-up portion of the unincorporated community known as Petersburg. There are about 250 inhabitants, a number of dwellings, two churches, a schoolhouse, two hotels, a shirt factory, laundry, stores, and two grist mills. All the dwellings are of wood. There is no fire protection whatever and the domestic supply of water is taken entirely from wells and springs. The plans of the district contemplated the construction of a reservoir of one and one-quarter million gallons capacity at an elevation of 150 feet above the highest section of the district, and about three-quarters of a mile distant upon the Fly creek, a small brook in the town of Petersburg, which yields, by measurement made in a dry period, 47,000 gallons per day. The water will be taken from the reservoir by gravity in a 4-inch cast-iron pipe to the distributing system, upon which fire hydrants will be located so as to protect every building in the district. The quantity of water will be sufficient with economical use to supply the needs of the district for domestic purposes and furnish fire protection for the present. The cost of the proposed system is about $5,000, which is to be raised upon the district by issuing its bonds to that amount.

Fly creek flows into the Little Hoosick river, a tributary of the Hudson. No use of its waters have heretofore been made for any municipal or manufacturing purpose and no other civil division of the State or municipality lies within its water shed.

The water is very soft, and if care is used in protecting the stream and reservoir from possible pollution, the supply will be an excellent one.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the Water Commissioners of the Water District of the Town of Petersburg are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities

and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the Water Commissioners of the Water District of the Town of Petersburg for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany this 14th day of October, 1909.

[L. S.]

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 63.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the VILLAGE OF LIVONIA.
} *Decision.*

Application filed: July 20, 1909.

Hearings: At Livonia, August 5 and October 21, 1909.

Decision: October 21, 1909.

Livonia, incorporated in 1882, is situate in the northeast corner of Livingston county, about one and one-half miles east of Conesus lake. It is a residential village and its population has increased from 738 in 1900 to 872 in 1905, and is now about 900. The assessed value of the property in the village is upwards of $400,000. There is no village indebtedness except $18,000 for the present water supply system which was constructed in 1899, and consists of a reservoir located near the village and a distributing system laid down in all the streets. At the time of this construction the Retsof Mining Company, of Scranton, Pa., owned and was conducting a salt mining plant about one mile south of the village. This company owned a pipe line running from its plant to Conesus lake, a distance of about one and one-half miles, where it had an engine and pumping station by which it supplied its works with water from the lake. By an arrangement with the salt mining company the village extended a wrought-iron pipe line to the salt works and there made connection with its supply from the lake, and from 1899 to 1908 the salt company pumped the water from the lake through its pipe and through the village distribution line to the village reservoir, the village paying the company $600 annually for this service. In the summer of 1908 the salt company dismantled its plant and ceased to do business in the locality. Since then the village has operated the engine and pipe line under a lease which will expire in November, 1909. This arrangement has not proved economical to the village. The water from the lake is not entirely satisfactory, the salt company are unwilling to renew the lease, the wrought-iron pipe from the distributing system to the salt works is worn out, and an action is now pending against the village for diversion of the water from the lake. On March 16, 1909, the village electors adopted a proposition to expend $6,500 to obtain a new source of supply. Two plans have been considered by the village authorities. The first was to establish a new pumping station on Conesus lake and lay a new force main to the village connecting with the present distributing system. The second plan was to take water from springs and driven wells within the village limits and pump into the system. The estimated cost of the first plan was $11,000 for construction and from $900 to $1,000 per year for operation, and of the second plan $6,500 for construction and from $780 to $800 per annum for operation. The application presented to us contemplates carrying out the second plan. The new source of the proposed supply is a dug well and an open spring on the property of J. O. Nickerson, situated in the southwest portion of the village within 1,500 feet of the business center. The village lies upon a side hill and has two small brooks passing through it from east to west, uniting in one at the west side of the village. The spring and dug well are located near the southern branch of this brook and at a lower elevation than the populated portion of the village. It was estimated by the engineer for the village that the consumption of water will amount to 33,000 gallons per day at the maximum and that the spring and dug well are alone capable of furnishing that amount. Two driven wells have also been sunk upon the same premises near the spring and the dug well, one to a depth of 180 feet and the other to a depth of 135 feet. In order to use these driven wells it will be necessary to install deep well pumps to be operated independent of the pumps which the village proposes to install under their present plan. These driven wells are to be held in reserve in case of the failure of the spring.

No objections were made or filed to the plans of the village.

In some of the streets there is a combined sewer system constructed by private interests, but the village has no system of sewers and it is apparent that a large number of houses probably use cesspools for the disposal of their sewage, and under the circumstances there is probability that the water in the open well and perhaps the spring, will be in danger of contamination from the seepage through the soil from the unsewered portions of the village and it will be quite essential that a close watch be kept on the purity of the water. The report submitted by the applicant of the analyses and of the bacteriological examination of the water taken from the spring, the reservoir and the well were made on samples taken May 6, 1909. They show the water to be a good potable water, but hard. Bacteria were present in all three samples, but in none of these was B. coli found. Subsequent examinations made of the spring and the dug well show the water to be somewhat contaminated and in its present condition not suitable for use for household purposes. The water from the driven wells is of good quality and is suitable for use for all purposes of the household, including drinking. It was shown, however, that the samples of water taken from the dug well and springs were contaminated with surface water and that the plans of the village propose such protection of the well and spring that pollution from surface waters will be practically impossible.

No other municipalities or civil divisions of the State are affected by the plans of the village of Livonia, and the estimated cost of the plant appears to be ample for the execution of the work.

The State Water Supply Commission determines:

(1) That the plans proposed by the village of Livonia are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the village of Livonia for a new or additional source ot water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

[L. S.] IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany this 21st day of October, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPLICATION NO. 65.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter
of
The Application of the VILLAGE OF PAINTED POST, N. Y., for the approval of its maps, plans and profiles for a new source of water supply.
Decision.

Application filed: August 18, 1909.

Hearing: September 3, 1909.

Decision: September 3, 1909.

On the 18th day of August, 1909, the village of Painted Post filed with this Commission an application for the approval of its maps, plans and profiles for an additional source of water supply. Accompanying that petition was a report of Knight & Hopkins, engineers, of Rome, N. Y., and the report of Nelson & Lauder, chemists, of Binghamton, N. Y.

This village has a population of over 1200 people, and has been settled for more than 100 years. During all of this time the water for domestic and fire purposes has been drawn from driven or excavated wells. There are no sewers in the village, and all the sewage from dwellings, barns, stables, etc., has drained into the soil during all this time. At present there is no public water supply. There has been a supply for fire protection but that has, at the present time, been abandoned. This village has voted to raise money to install a municipal water plant. The plan of the village is to go about a half mile north of the center of the village and sink driven wells through the soil and clay to gravel, build a pumping station and pump the water into a concrete reservoir about 200 feet above the village. This reservoir will hold half a million gallons, and from there the water will run through pipes into a distributing system that will reach all of the dwelling houses in the village. The system will furnish a fire pressure of about eighty pounds to the square inch, and a sufficient number of hydrants will be provided.

The water, as appears from the analysis, is of a good quality, and will be sufficient to furnish an abundant supply for potable purposes and fire protection for this village for many years to come.

The plans of the village have been so devised that additional wells can be driven and mains extended whenever the growth of the village will demand it. The cost is estimated to be about $33,000 without making deductions for pipes upon streets which are not now built upon. The location of the wells and pumping station are such that they will not interfere with the water supply of any other municipality or civil division of the State, neither will they cause any damage to any riparian owner, or owner of water rights except the taking of the land occupied by the wells, pumping station and reservoir. This land the village already has under option for purchase. The money received from the sale of the bonds voted by the village is ample to pay any and all damages that may be done to any property owner, and such is the purpose of the village. The village has a number of industries that employ a large number of men and is steadily growing in population. It therefore appears from the evidence given upon the hearing, that there is a public necessity for a municipal water supply for the village of Painted Post.

The State Water Supply Commission therefore determines:

(1) That the plans proposed by the village of Painted Post are justified by public necessity.

(2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the village of Painted Post for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys, and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

[L. S.] IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany this 3d day of September, 1909.

HENRY H. PERSONS,
President.
ERNST J. LEDERLE,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
Commissioners.

APPENDIX C.

LAWS RELATING TO THE COMMISSION.

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LAWS RELATING TO THE COMMISSION.

The general laws establishing the State Water Supply Commission and prescribing its duties were consolidated by Chapter 56 of the Laws of 1909, Article 2 of the State Boards and Commissions Law, being Chapter 54 of the Consolidated Laws.

ARTICLE 2.

State Water Supply Commission.

Section 5. State water supply commission.
6. Municipal corporations must submit maps and profiles of new or additional sources of water supply.
7. Petition for approval of plans for water supply and proceedings thereupon.
8. Powers of commission on investigation of plans for water supply.
9. Acquiring of land by aqueduct commissioners of New York city not affected.
10. Petition for river improvement.
11. Determination upon petition for river improvement.
12. Proceedings upon approval of petition for river improvement.
13. Proceedings after final order approving petition for river improvement.
14. Entry upon lands, structures and waters in proceeding for river improvement.
15. Compensation of owners upon failure to agree in proceeding for river improvement.
16. Warrant for payment of owners upon failure to agree in proceeding for river improvement.
17. Final statement and apportionment of cost of river improvements.
18. Proceedings for collection of cost of river improvements.
19. Bonds for river improvements.
20. River improvement certificates.
21. Operation, maintenance and expenses of river improvements and unlawful opening of gates of dam.
22. Construction of provisions relating to river improvements.
23. Investigation and report as to state system of water supply and sewerage.
24. Annual report by commissioners to legislature.

§ 5. **State water supply commission.**— The state water supply commission is continued. The commission shall consist of five members appointed by the governor by and with the advice and consent of the senate. One of the members shall be designated as president. Any three of said commissioners shall constitute a quorum for the transaction of business. The commission shall make necessary rules and regulations for the proceedings hereunder. The commission shall have an official seal. The term of each member of the commission shall be five years, except that the members of said commission first appointed shall hold office respectively one for one year, one for two years, one for three years, one for four years, and one for five years, and as the term of each commissioner expires or otherwise becomes vacant his successor shall be appointed in the manner hereinbefore provided for the appointment of the original commissioners. The members of the commission shall receive an annual salary of five thousand dollars each and be paid their necessary and reasonable expenses actually incurred in the prosecution of their duties, payable monthly. The commission is hereby authorized and empowered to employ a secretary and such engineers, stenographers, clerks and other subordinates as the duties imposed upon them by this article may require, and to fix and pay the reasonable salaries and expenses of such officers, and of all other subordinates for the purpose of proceedings by them under this article, subject to the approval of the governor.

§ 6. **Municipal corporations must submit maps and profiles of new or additional sources of water supply.**— No municipal corporation or other civil division of the state, and no board, commission or other body of or for any such municipal corporation or other civil division of the state shall, nor shall any person or water-works corporation engaged in supplying or proposing to supply the inhabitants of any municipal corporation with water, after this chapter takes effect, have any power to acquire, take, or condemn lands for any new or additional sources of water supply, until such person, corporation or civil division, has first submitted the maps and profiles therefor to said commission, as hereinafter provided, and until said commission shall have approved the same.

§ 7. **Petition for approval of plans for water supply and proceedings thereupon.**— Any municipal corporation or other civil division of the state, or any person or water-works corporation, may make application by petition in writing to the said commission for the approval of its maps and profiles of such new or additional source or sources of water supply. Such application shall be accompanied by an exhibit of maps of the lands to be acquired and profiles thereof showing the sites and areas of the proposed reservoirs and other works, the profiles of the aqueduct lines and the flow lines of the water when impounded, plans and surveys and abstract of official reports relating to the same, showing the need for a particular source or sources of supply and the reasons therefor, and shall be accompanied by a plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans. Such petition shall also be accompanied by such proof as to the character and purity of the water supply proposed to be acquired as the state water supply commission shall require. If such petition is made by a person or water-works corporation, it shall be accompanied by an undertaking in such amount and with such sureties as the state water supply commission shall determine, that such person or water-works corporation will pay the expenses of the hearing and determination as hereinafter provided. Said commission shall thereupon cause public notice to be given that on a day therein named the commission will meet at its office in the city of Albany, or at such other place as it may particularly specify in said notice, for the purpose of hearing all persons, municipal corporations or other civil divisions of the state that may be affected thereby. Such notice shall be published in such newspapers and for such length of time, not exceeding four weeks, as the commission shall determine. At any time prior to the day specified in such notice any person or municipal corporation or the proper authorities of any civil division of the state may file in the office of the commission at Albany objections to the project proposed by such application. Every objection so filed shall particularly specify the ground thereof. Said commission shall, upon the day specified in said notice, or upon such subsequent day or days to which it may adjourn the hearing, proceed to examine the said maps and profiles and to hear the proofs and arguments submitted in support of and in opposition to the proposed project, but no person, municipal corporation or local authorities shall be heard in opposition thereto except on objections filed as authorized by this section. The commission shall determine whether the plans proposed are justified by public necessity, and whether such plans are just and equitable to the other municipalities and civil divisions of the state affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and whether said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans. Said commission shall within ninety days after the final hearing and with all convenient speed, either approve such application as presented or with such modifications in the plans submitted as it may deem necessary to protect the water supply and the interest of any other municipal corporation, or other civil division of the state, or the inhabitants thereof, or to bring into co-operation all municipal corporations, or other civil divisions of the state, which may be affected thereby. Or it may reject the application entirely or permit another to be filed in lieu thereof, but it shall, however, make a reasonable effort to meet the needs of the applicant, with due regard to the actual or prospective needs and interests of all other municipal corporations and civil divisions of the state affected thereby and the inhabitants thereof. Whenever the commission shall make a decision on any application submitted to it, it shall state the same in writing and sign the same and cause its official seal to be affixed thereto and file the same, together with all plans, maps, surveys and other papers or records relating thereto in its office. The decision of the commission and its action on any application may be reviewed by certiorari proceedings. The expense of any such hearing and determination by the commission shall be certified by said commission to the person, water-works corporation, municipal corporation or other civil division of the state making such application and shall be paid by said applicant within thirty days thereafter upon the certificate of the commission to the persons entitled thereto.

§ 8. **Powers of commission on investigation of plans for water supply.**— Said commission shall have power to subpœna and require the attendance in this state of witnesses and the production by them of books and papers pertinent to the investigation and inquiries which it is authorized to make by this article, and to examine them and such public records as it shall require in relation thereto. And for the purposes of the examinations authorized by this article, the commission shall possess all the powers conferred by the legislative law upon a committee of the legislature or by the code of civil procedure upon a board or committee, and may invoke the power of any court of record in the state to compel the attendance and testifying of witnesses and the production by them of books and papers as aforesaid.

§ 9. **Acquiring of land by aqueduct commissioners of New York city not affected.**— Nothing contained in the preceding sections shall in any way affect the acquiring of lands by the aqueduct commissioners of the city of New York under the provisions of chapter four hundred and ninety of the laws of eighteen hundred and eighty-three as heretofore amended.

§ 10. **Petition for river improvement.**— Any county, city, town or village located upon any river or water course, or any person or persons possessing riparian rights thereon, may present to the commission a petition duly verified, setting forth the facts showing that the restricted or unrestricted flow thereof is a menace to the public health and safety and that it is necessary to the preservation of the public health and safety to regulate the same, and praying that the flow of water in such river or water course shall be regulated under the following provisions of this article, so far as necessary for that purpose. Such petition may be made on behalf of any county by the board of supervisors thereof, on behalf of any town by the supervisor thereof, on behalf of any city by the mayor or board of aldermen thereof, on behalf of any village by the president or board of trustees thereof.

§ 11. **Determination upon petition for river improvement.**— Such commission on receipt of any such petition shall forthwith determine whether the regulation of the flow of any such river or water course is of sufficient importance to the public health or safety to warrant the interference of the state under the provisions of this article, and shall certify its determination thereupon. If it shall determine that the relief prayed for should be granted, such commission shall at once make or cause to be made such preliminary surveys and investigations as may be proper to determine the causes of the excessive, restricted or irregular flow in such river or water course, the available means to correct the same for the preservation of the public health and safety, and if relief therefrom is in the opinion of the commission practicable, to take such other and further action with reference to relieving the same as is hereinafter provided for.

§ 12. **Proceedings upon approval of petition for river improvement.**— If such commission shall determine that a more beneficial flow of water in such river or water course can be had by construction of dykes, clearing out or changing the channel, the erection of a dam or dams or other public works thereon, or upon any tributary thereof, it shall cause to be made preliminary plans and specifications of such proposed improvements, together with a survey of the lands upon which such improvements are to be located, giving the location thereof, and of all lands to be taken, flowed or damaged thereby, with a description by survey or otherwise, of all rights affected thereby, and estimates of the total cost thereof. The commission shall also cause a map to be made showing all such lands, the number of acres in each separate tract and the names of the owners and occupants thereof so far as the said commission can ascertain the same. The commission or the members thereof may enter upon such lands as the commission shall deem necessary for the purpose of doing such work, either by themselves or by their engineers, agents or servants employed by them for that purpose. The commission shall also prepare a statement or list of the counties, towns, cities, villages and individual properties which in its judgment will be benefited thereby, together with a statement of the proportional share of said total cost which should be borne by the said counties, towns, cities and villages respectively, and by the individual owners of property benefited collectively, expressed in decimals; and in case any part or proportion of the cost of such improvement is not properly assessable upon the counties, towns, cities, villages or individual properties, or any of them, as not in the nature of a local improvement, such part or proportion of the expense shall be deducted from the total cost before apportioning the same upon the counties, towns, cities, villages and individual properties as aforesaid, and shall be certified by the said commission to the legislature as a state charge. Such preliminary maps, plans, specifications, estimates and statements shall thereupon be filed in the office of the county clerk of any county benefited and of each county in which any of the aforesaid towns, cities, villages or individual properties benefited are situated. Upon the completion and filing of such preliminary maps, plans, specifications, estimates and statements, the commission shall give notice of the filing thereof, and of the time and place where said commission will give a hearing to persons interested therein, by advertising for five weeks in two newspapers published in each county where such improvement is proposed to be made, and in the state paper published at Albany, at which time and place any person interested may appear, and make any objection to or suggest any modification in said plans and specifications, and said commission shall have power to adjourn said hearing from time to time as justice may require. Thereupon said commission shall determine whether such proposed improvement shall be abandoned or proceeded with, and what, if any, modifications should be made in said plans, specifications, estimates and statements. If said commission shall determine that said maps and plans should be modified so as to include territory to be benefited or otherwise, not included in the maps, plans and statements already filed, then they shall cause modified maps, plans, specifications, estimates and statements to be prepared and filed as hereinbefore provided, for said preliminary maps, plans, specifications, estimates and statements, and shall give notice of their completion and filing and of a hearing thereupon, in the manner hereinbefore prescribed for a hearing upon said preliminary maps, plans, specifications, estimates and statements. If said commission shall finally determine that the proposed improvement be made, it shall thereupon make a final order directing the same to be made, and shall cause to be prepared a final map, detailed plans, specifications and estimates of the total cost thereof. The commission shall cause the said final order, map, plans, specifications and estimates, or duplicates thereof, certified by them, to be filed in the office of the county clerk of each county in which lands affected or benefited thereby are located. No such improvement shall be undertaken under this article pursuant to any such final order, or any other proceedings had thereon except as hereinbefore provided, until after the said final order shall have been approved by a subsequent act of the legislature which act shall authorize and direct such improvement to be made. If so approved, the said final order shall become effectual and not otherwise.

§ 13. Proceedings after final order approving petition for river improvement.— When any such final order shall have been made and approved by an act of the legislature as hereinbefore provided, such commission shall advertise two successive weeks in the state paper and in two newspapers published in the county wherein such work is to be performed, and if in more than one county then in each of such counties, and in such other newspaper as shall be deemed of advantage, for bids or proposals for said work to be made in writing for the construction of such dam or dams, dykes or other works according to such plans and specifications. Upon the receipt of the proposals, such commission may enter into a contract or contracts with the lowest responsible bidders for the work to be done, or may reject any or all bids and again advertise for further bids. Before entering into any such contract, a bond with sufficient sureties shall be required, conditioned that the contractor will perform all work within the time prescribed in accordance with the plans and specifications, and will indemnify the state and said commission of and from all liability for damages occasioned or suffered by reason of the negligence or wilful fault of such contractor, his employees or any subcontractor or his employees in doing such work. Partial payments for work actually done may be provided for in the contracts and paid in the manner hereinafter provided to an amount not to exceed ninety per centum of the contract price. The payments due on account of any such contracts or for any necessary expense or work in connection therewith in pursuance of this article shall be paid from the river improvement fund as hereinafter provided for.

§ 14. **Entry upon lands, structures and waters in proceeding for river improvement.**— The commission may enter upon any land, structures and waters which in its judgment shall be necessary to enter upon for the purposes of this article so far as the same relates to proceedings for the improvement of rivers and water courses. If the owner of any property to be taken for such improvement shall agree with said commission upon the sum to be paid therefor, or for any damages sustained, such sum shall be paid as hereinafter provided as part of the necessary expense incurred in carrying out any such improvement under the provisions of this article.

§ 15. **Compensation of owners upon failure to agree in proceeding for river improvement.**— If the commission can not agree with the owners upon the compensation and damages to be paid for the property to be so taken and appropriated, the commission shall thereupon serve upon such persons a notice that the lands and property described therein have been appropriated by the state for the purposes of this article, and shall proceed to acquire title thereto under the provisions of title one of chapter twenty-three of the code of civil procedure, known as the condemnation law.

§ 16. **Warrant for payment of owners upon failure to agree in proceeding for river improvement.**— When proceedings are taken under the condemnation law as provided in the preceding section the commission shall file in the comptroller's office a certified copy of the final order provided for in section thirty-three hundred and seventy-one of the code of civil procedure, and a certified copy of the judgment therein rendered pursuant to section thirty-three hundred and seventy-three of said code, together with a certificate of the attorney-general that no appeal from such final order and judgment has been or will be taken by the state, or if an appeal has been taken, a certified copy of the final judgment of the appellate court affirming in whole or in part said final judgment. The comptroller shall issue to the said commission or such officer thereof, as it shall direct, his warrant for the payment of the amount due upon such final order and judgment with interest from the date of the judgment until the thirtieth day after the entry of such final order and judgment, and the same shall be paid out of the river improvement fund hereinafter provided for. Such warrant shall be payable to and shall be delivered by the commission or its officers to the owner or owners of said judgment according to the terms thereof.

§ 17. **Final statement and apportionment of cost of river improvements.**— As soon as the total cost of such improvements, including compensation for lands, property, property rights and all damages whatsoever suffered by reason thereof, and all expenses of the commission necessarily incurred or to be incurred in connection therewith, less the amount thereof chargeable to the state, can be determined, said commission shall make a complete and detailed verified statement thereof. They shall apportion the same between the respective counties, towns, cities, villages and individual properties which according to their determination made as hereinbefore provided, are benefited by said improvements. Said apportionment shall be in writing, and shall specify the proportion thereof to be paid by each of said counties, towns, cities and villages as a whole for public benefits which each as a whole will receive therefrom, and it shall specify the benefits of individual properties, whether in such counties, cities, towns and villages aforesaid or not. The commission shall express such proportions in decimals according to the benefits received therefrom, and shall determine whether the same shall be paid in one assessment or in annual assessments not exceeding twenty in all. If the commission determine that the sum so apportioned shall be paid in annual instalments, it shall add to each apportionment an amount sufficient to pay all necessary interest money, specifying the amount of each instalment. Upon completion of such apportionment, the commission shall cause a true copy thereof to be served upon the chairman of the board of supervisors of each county, the mayor of each city, the supervisor of a town, the president of a village named in said apportionment, or if service can not be had upon such mayor, supervisor, or president, then upon the board of aldermen of the city, the town board of the town, or the board of trustees of the village, by delivering the same openly to one of them while in session. A copy thereof shall also be served upon each individual owner of property assessed, either by delivery to such owner or by posting the same upon the said property, and by duly publishing a copy thereof for three weeks in two newspapers published in the county where such property is situated. With such apportionment and as a part thereof, shall be served a notice specifying a time and place where such commission shall meet to hear any county, town, city, village or person interested or aggrieved thereby. Said apportionment and notice shall be served at least fifteen days before such meeting if the service is personal, and at least three weeks before said meeting, if the same is by publication. The affidavit of the person serving or publishing such notice shall be evidence thereof. The commission shall meet at the time and place specified and hear all persons interested in or aggrieved by said apportionment. After such hearing the commission may modify or amend such apportionment in which case it shall serve a true copy thereof and notice of a hearing thereon in the same manner upon the same conditions and with the same force and effect as the first apportionment and notices. Any county, city, town or village, or any person deeming itself aggrieved may review the determination of the commission in the same manner as a review is had of the determination of a board of assessors in making an assessment. Whenever it shall be determined by the commission that any portion of the total cost of such improvement shall be borne by the individual properties benefited, it shall proceed to apportion that part among such individual properties in the following manner: A committee of three of its members shall be appointed who shall have power to apportion and assess such cost upon the individual properties benefited in proportion to the benefit received. Said committee shall prepare or cause to be prepared a list showing each parcel benefited together with the name of the owner thereof so far as the same can be ascertained. The said committee shall view the premises and determine the proportion of benefit received by each parcel. They shall thereupon cause to be prepared a statement of their determination showing the parcels benefited with the proportion of benefit received expressed in decimals. They shall cause a copy of such statement to be served upon the owner or owners of each parcel assessed together with notice of a time and place not less than two weeks at which a hearing will be given thereon, at which any person deeming himself aggrieved shall be heard. Such notice shall be served personally, and in case personal service can not be made, by publication thereof for two weeks in two newspapers published in the county where said property is situated. Upon said hearing the committee may confirm, modify or alter their determination, and shall thereupon make a final decision assessing that portion of the cost of such improvement to be borne by the individual properties benefited, upon the said properties in proportion to the benefit received expressed in decimals, and determining whether the same shall be paid in one sum or in annual instalments not exceeding twenty in all, and shall cause a copy thereof to be served upon the owner or owners of each parcel assessed. The determination of such committee may be reviewed in the same manner as a review is had of a determination of the board of assessors in making an assessment. The said committee shall report such final determination and assessment with their proceedings thereon to the commission and upon the adoption and confirmation thereof by said commission the same shall be and become operative as an apportionment and assessment of the costs and expenses to be borne by the individual properties benefited by such improvement.

§ 18. **Proceedings for collection of cost of river improvements.**— The commission shall then make a final statement of the total cost and expense of such improvement and of the apportionment and assessment thereof, and file the same as hereinafter provided. Said statement shall contain a statement of the total amount of said costs and expenses, and a statement of the respective counties, cities, towns and villages benefited thereby with the proportion of benefit received by each county, city, town or village expressed in decimals. It shall also contain a statement of the amount of such costs and expenses which is to be paid by the individual properties benefited, with a description of each parcel, the name of the owner or owners, so far as known, the city, town or village where situated and the proportion of benefit received expressed in decimals. It shall also contain a statement whether the amount so assessed upon any county, city, town, village or individual is to be paid in one sum or in annual instalments as hereinbefore provided and the amount of each annual instalment in case the same is to be so paid. A copy of such statement duly verified under the seal of the commission shall be filed with the clerk of each county, town, city or village containing any lands herein stated to be benefited. The clerk of such county, city, town or village, shall make and deliver to the board of supervisors of such county, the common council of such city, the board of trustees of such village, and the assessors of such town, city or village, a copy of such statement. The board of supervisors of each such county shall levy and assess upon the county and upon each town specified in such statement the amount of such benefit which in such statement is certified to be the proportion which should be borne by the county or by such town as a whole. The common council of each city and the board of trustees of each village shall in like manner levy and assess upon such cities and villages respectively the amount stated in such statement which should be paid by each of such cities and villages respectively. The assessors of each town, city or village containing individual properties upon which a portion of such cost is assessed shall enter on a separate page in their assessment roll a statement of the total amount to be so paid by such individual properties, a description of each parcel and the proportion of benefit received expressed in decimals, as contained in the statement filed with them. And the board of supervisors of each county where such property is situated shall levy and assess against each such parcel so much of the amount to be raised as shall correspond with the amount of benefit received as indicated by the decimal set down after the description thereof as hereinbefore provided and shall by their warrant direct the collection thereof in the same manner and by the same procedure as general taxes are collected, except that no personal property of the owner of the parcel shall be seized or sold to pay the tax, and that the particular tax assessed on account of such improvement, shall be satisfied only by a sale and conveyance of the parcel benefited. And in case it is determined that the amount required is to be paid in annual instalments, the board of supervisors or the assessors of the city, town or village, as the case may be, shall annually assess the annual instalment to be paid by such county, city, town, village or individual, in the manner provided by this section, until the whole shall be paid. Upon the assessment by the commission of the benefits as provided in this section, the amounts apportioned shall be and remain charges against the several municipalities and liens upon the several parcels of property charged therewith, until paid or otherwise removed, superior in force and effect to all other liens except unpaid general taxes. All moneys collected under and by virtue of the provisions of this article so far as the same relates to the improvement of rivers and water courses shall be paid to the county treasurer of the county benefited or of the county in which the town, city, village or property is located, who shall pay the same on or before the first day of June in each year to the comptroller of the state, who shall deposit the same in a depository bank to the credit of the river improvement fund as herein provided for. Provided, however, that any county, city, village or individual who may elect to pay the whole of their apportionment, or the portion thereof at any time remaining unpaid, instead of in instalments as hereinbefore provided, may pay the same to the county treasurer, and be discharged therefrom.

§ 19. **Bonds for river improvements.**— The commission, after any such final order shall have been approved by the legislature, may from time to time make and issue bonds to pay the cost of improvements to rivers and water courses under this article. Separate issues of bonds shall be made for each separate work of such improvement, and no issue shall exceed the aggregate cost of the improvement on which such issue of bonds is made. Such bonds shall show upon their face that the payment thereof is secured by an assessment which shall be made as provided in this article, for an improvement made as provided in this article, and the proceeds of the assessment for the improvement on which such bonds are issued shall be pledged for the payment of such issue of bonds. They shall by their terms become due and payable as determined by the commission not exceeding twenty years from the date of issue, and bearing interest not exceeding five per centum per annum, payable semiannually. Before issue such bonds must be approved as to amount, and countersigned by the comptroller. They shall also be signed by the president of the commission, and have the seal of the commission attached thereto. Such bonds shall be exempt from taxation in this state. They shall be sold by the comptroller at not less than par and accrued interest, and the proceeds thereof deposited in a national or state bank either at Albany or in one of the counties in which such improvement is made, to be approved by said comptroller and the president of the commission. But before any such deposit is made, the comptroller shall require from such bank a bond as security for repayment of the same, to be approved by him as to form, conditions and sufficiency of sureties which shall provide for the repayment to such commission upon demand of the moneys so deposited. Moneys received under the provisions of this article so far as the same relates to the improvement of rivers and water courses shall constitute a fund to be known as the river improvement fund. and all requisitions of the commission for payments for the purposes of this article shall be made by the commission or the officer of the commission authorized by it so to do and countersigned by the comptroller, upon that part of the river improvement fund applicable to the improvement for which such requisition is made.

§ 20. **River improvement certificates.**— To temporarily provide for the expenditures which must necessarily be made before the proceeds from the sale of the bonds hereinbefore authorized to be issued become available, the commission is hereby authorized to issue certificates of indebtedness bearing interest at five per centum per annum which may be used only for the payment of liabilities incurred under this article so far as the same relates to improvements of rivers and water courses in anticipation of the issue and sale of bonds therefor. A separate issue of such certificates may be made for each separate work of such improvement, the amounts to be approved by the comptroller, not to exceed the aggregate estimated cost for such improvement made as in pursuance of section twelve of this chapter. These certificates shall be issued in the name of the commission and shall be styled "river improvement certificates." They shall be signed by the president of said commission, countersigned by the comptroller, shall have the seal of the commission attached, be attested by its secretary and be payable principal and interest from the river improvement fund created by this article in like manner and effect as requisitions by the commission are herein provided to be paid.

§ 21. **Operation, maintenance and expenses of river improvements and unlawful opening of gates of dam.**— The care, control, operation and maintenance of improvements to rivers and water courses provided for in this article shall devolve upon the commission, and the expenses thereof shall be a charge upon the various municipalities and properties according to the benefits derived therefrom respectively, to be collected in the same manner that the original cost and expense of the improvement was collected. The commission shall have power to charge to each such improvement undertaken by it such portion of the expenses so incurred as it shall determine ratably and equitably is chargeable thereto and to include the same in the apportionment or assessment of the cost and expenses of such improvement. Any person who shall open or close or cause to be opened or closed a gate or gates in any dam constructed under this article so far as the same relates to such improvements without the consent of the commission, or an officer thereof, shall be guilty of a misdemeanor.

§ 22. **Construction of provisions relating to river improvements.**— The provisions of this article, so far as the same relates to improvements to rivers and water courses, or the proceedings had or the work done in accordance therewith, shall not be construed as annulling or affecting any power of eminent domain, right, privilege or franchise heretofore created or conferred by law or acquired thereunder nor to permit the actual construction of any dam upon the lands which now constitute a private park under and pursuant to article four of the forest, fish and game law, or pursuant to law, without the consent of the owner of such lands.

§ 23. **Investigation and report as to state system of water supply and sewerage.**— The commission shall report the present disposition of sewerage of each municipal corporation and other civil division of the state, and, if necessary, of adjoining states, with special reference to said disposition affecting the various municipal corporations and other civil divisions of the state in relation to the water supply of this state. Said commission shall also report the advisability of, the time required for and the expenses incident to, the construction of a state system of water supply and for a state system for the disposition of sewerage, if necessary, for all or any of the municipal corporations and other civil divisions of this state, and make such recommendations connected with the subjects of said investigations herein provided for as said commission shall determine. In said investigation concerning either the water supply or disposition of sewerage, said commission shall, so far as possible, make use of all reports and surveys in regard thereto which have heretofore been made. For the purposes of such investigations as are provided for in this section said commission shall have all the powers and authority conferred by section eight of this chapter.

§ 24. **Annual report by commissioners to legislature.**— The commission shall annually on or before the first Monday in February in each year submit a written report to the legislature. This report shall contain:

1. An exhibit of the personnel of the commission and of all engineers and other persons connected with the commission.

2. A financial statement showing fully and clearly the condition of the finances of the commission, the amounts and dates of maturity of all bonds and certificates of indebtedness, the amounts of money received and their sources; the amounts of money paid and the purposes for which the same were paid.

3. A statement of the several petitions received by the commission and the action taken thereon.

4. A descriptive statement of each work of improvement on which work has been done during the previous year.

5. A statement of the conditions of improvements previously completed and the results secured by the work of improvement in each case.

In addition to the details as outlined above, the commission shall report to the legislature such other matters as it shall deem proper.

CHAP. 284, LAWS OF 1909.

AN ACT to amend the state board and commissions law, in relation to the powers of the state water supply commission.

Became a law May 4, 1909, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Article two of chapter fifty-six of the laws of nineteen hundred and nine, entitled "An act in relation to state boards and commissions, constituting chapter fifty-four of the consolidated laws," is hereby amended by adding at the end thereof two new sections to be sections twenty-five and twenty-six, to read, respectively, as follows:

§ 25. **State jurisdiction of the improvement of water courses at private expense.**— The board of trustees of any village may present to the state water supply commission a petition requesting such commission to assume jurisdiction of the construction of a proposed improvement to a water course adjacent to or in the vicinity of such village. Such petition shall state the location of such water course, the character of the proposed improvement, the estimated cost thereof, shall set forth the fact that unless such improvement is made such water course is a menace to the public health and safety of the inhabitants of such village, and shall request that the commission assume jurisdiction of the construction of such improvement, as provided by this section. The petition must also state that if the state water supply commission assumes jurisdiction of such improvement the money needed therefor will be deposited to the order of the commission in a national bank to be designated by it. The petition shall be accompanied by a plan for such improvement, together with an estimate of the cost thereof, prepared by a competent engineer. Upon the receipt of such petition, the commission shall forthwith cause an investigation to be made and shall determine whether the proposed improvement is of sufficient importance to the public health or safety to warrant the commission in assuming jurisdiction. If it shall determine in the affirmative, the commission shall cause to be made an estimate of the cost thereof, and upon the deposit of money in an amount equal to such estimated cost, the commission shall cause such improvement to be made substantially in accordance with the plan proposed by the petition. If such improvement involves the acquisition of land or water rights the commission may acquire the same by condemnation, if unable to agree upon a purchase price, and shall pay the expenses of proceedings and the awards therein out of the money deposited to its credit. If the improvement consists of the construction or improvement of a dam, the petition may state the levels at which it is proposed to maintain the water stored by such dam, and if the commission accepts jurisdiction of the contruction of such improvement in accordance with this section, it shall cause the water stored by such dam to be maintained at the level specified in such petition.

§ 26. **Refund of expenses in certain cases.**— If subsequent to the construction of such improvement at private expense as provided by this section, the state shall improve such water course, pursuant to the provisions of this chapter, and the dam or other structure constructed or improved at private expense, as provided by this section, would naturally constitute a part of the plan for the improvement of such water course by the state, the persons by whom the money to make such improvement was contributed may present a claim therefor to the court of claims. Jurisdiction is hereby conferred upon the court of claims to hear such claim, and if the court shall determine that the improvement was paid for by the claimants and would have naturally constituted a part of the improvement of such water course by the state if such improvement had not already been made at private expense, the court shall award to such claimants the amount of money contributed by them toward such expense, and the amount of such awards shall be payable from the money appropriated for the greater improvement of which such improvement would naturally constitute a part.

§ 2. This act shall take effect immediately.

CHAP. 464, LAWS OF 1909.

AN ACT to amend the state boards and commissions law, in relation to river improvement.

Became a law May 24, 1909, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter fifty-six of the laws of nineteen hundred and nine, entitled "An act in relation to state boards and commissions, constituting chapter fifty-four of the consolidated laws," is hereby amended by adding thereto, after section twelve, a new section to be section twelve-a thereof, to read as follows:

§ 12-a. **Creation of improvement districts.**— At any time after such final order shall have been approved by the legislature the commission shall determine what property included in the statement or list as specified in section twelve of this chapter, other than counties, towns, cities and villages, is to be benefited by such improvement, and it shall thereupon cause to be made a survey and map showing the lands so determined to *benefited and the name of the owner of each separate parcel so far as practicable, the quantity in each parcel and the boundary lines thereof and where a parcel is intersected by a town or county line the quantity in such parcel on each side of the town or county line; and shall give to each parcel a corresponding number on said survey and map; and it shall also cause to be made a brief description or designation sufficient to identify the same, of all other property included in such statement or list so determined to be benefited, with the name of the owner thereof so far as practicable. When said survey and map and descriptions are completed a copy thereof with a certificate of their adoption duly signed by the commission shall be filed in the office of the clerk of each county in which any lands or property so determined to be benefited are situated or exist; and thereafter the commission shall fix a time and place in such county where the owners of said lands and property and other persons interested therein shall have an opportunity to be heard as to the lands and property to be benefited. Notice of the time and place of such hearing shall be given by the commission by notice published at least once a week for two successive weeks immediately prior to the time of such meeting in at least two newspapers published in such county. After such hearings, which may be adjourned from time to time by the commission or by any member thereof, the commission may make any change in its determination as to the lands and property to be benefited; in case of any such change the commission shall make a supplemental survey and map and descriptions, in like manner as is hereinbefore provided with reference to the original survey and map and descriptions, showing such changes, and file in the clerk's office of each county where the lands and properties affected by such changes are situated or exist a copy of such supplemental survey and map and descriptions with a certificate of their adoption duly signed by the commission; and thereupon such original survey and map and descriptions, as modified by such supplemental survey and map and descriptions, if any, shall constitute the final determination of the commission as to the lands and property to be benefited by such improvement. Such final determination may be reviewed in like manner as a review is had of a determination of a board of assessors in making an assessment. Such determination as modified upon such review, if any, shall conclusively fix and establish the lands and properties benefited by said improvement, and the same together with the counties, towns, cities and villages included in said statement or list shall constitute an improvement district; and the proportional share of the total cost of such improvement and of the maintenance thereof so apportioned to the state and the counties, towns, cities and villages as provided in section twelve of this chapter shall be a charge upon and be payable by the state and said counties, towns, cities and villages respectively, and the proportional share thereof collectively charged upon the lands and properties within such improvement district as in this act provided shall be a lien upon all the lands and properties within such improvement district and shall be borne by and assessed and levied upon and collected from such lands and properties in the manner hereinafter provided.

§ 2. Sections fourteen, seventeen, eighteen, nineteen, twenty and twenty-one of such chapter are hereby amended to read, respectively, as follows:

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* So in the original.

§ 14. **Entry upon lands, structures and waters in proceeding for river improvement.**— The commission may enter upon any land, structures and waters necessary for the purposes of this article so far as the same relates to proceedings for the improvement of rivers and water courses; and it may determine that the right to temporary or perpetual use and occupancy of the property to be taken for the purpose of such improvement is a sufficient title and interest to be acquired therein. If the owner of any property to be taken for such improvement shall agree with the commission upon the sum to be paid therefor, or for the right to use and occupy the same or for any damages sustained, such sum shall be paid as hereafter provided as part of the necessary expense incurred for the purpose of such improvement.

§ 17. **Bonds for river improvement.**— To pay the cost of such improvement and all the expenses and liabilities lawfully incurred by the commission under this article in connection therewith and the maintenance thereof and the certificates authorized by this article to be issued and the interest thereon the commission is hereby authorized to issue, in the name of and under the seal of said commission, in behalf of such improvement district, bonds in a sum not exceeding the amount of the estimated total cost of said improvement and ten per centum thereof in addition thereto, unless the legislature shall under the provisions of section twelve of this chapter authorize the expenditure of an additional amount in excess of ten per centum of the amount of said estimated cost by a further final order as therein provided, in which case such bonds may be issued for such additional amount. Such bonds, together with interest thereon at a rate not exceeding five per centum, payable semi-annually, shall be payable by their terms by the state, municipality and by assessment and levy of taxes upon the lands and properties in such improvement district according to the proportional share thereof determined as herein provided, and they shall be executed when authorized by the commission by the president of the commission and attested by the secretary thereof. Such bonds shall be issued in serial form in amounts to be fixed by the commission; they shall by their terms become due and payable as determined by the commission in not exceeding fifty years from the date of issue, and they shall be exempt from all taxation by the state or by any county, town, city, village or other subdivision of the state, and shall be a legal investment for savings banks, trust companies, executors and trustees. Such bonds shall be sold by the comptroller at not less than par and accrued interest, and the proceeds thereof deposited in a national or state bank either at Albany or in one of the counties in which such improvement is made, to be approved by the comptroller and the president of the commission. But before any such deposit is made, the comptroller shall require from the depository a bond as security for the repayment of the same, to be approved by him as to form, condition and sufficiency of sureties, which shall provide for the repayment to the commission upon demand of the moneys so deposited. Moneys received under the provisions of this article shall constitute a fund to be known as the river improvement fund, and the portion thereof applicable to each improvement shall be separately kept by the comptroller, and the same are hereby pledged to the payment of the cost and expenses of such improvement and the maintenance thereof, and the bonds and certificates to be issued as in this article provided, so far as the same are applicable to such improvement, and the comptroller is authorized and directed to pay therefrom the principal and interest of said bonds as the same mature and become payable by the terms thereof, and the principal and interest of any certificates issued in pursuance of section twenty of this chapter, and the costs and expenses of such improvement and the maintenance thereof upon the order of the commission or the authorized officer thereof. In case the proceeds of the sale of bonds exceed the total amount of the cost and expenses of such improvement, including the interest on certificates, such excess shall be applied by the comptroller to the payment of the principal and interest of such bonds and the maintenance of such improvement.

§ 18. **Proceedings for apportionment of cost of river improvements.**— The commission shall assess upon the lands and properties in such improvement district benefited collectively as determined under the provisions of section twelve of this chapter, the benefit accruing thereto by reason of such improvement in the following manner: It shall determine after an investigation thereof the amount of such benefit received by said lands and properties and shall specify the same in a statement thereof opposite the number of each parcel of land and each designation or description of property corresponding with the number thereof on said survey and map and descriptions of such improvement district with the name of the owner or owners thereof, as the same appear on said map and survey and descriptions; such statement shall be signed by the commission and a copy of so much thereof duly certified by the secretary of the commission shall be filed in the clerk's office of each county as relates to the lands and property included in each county. A copy of such statement shall be served upon the owner or owners of such lands and properties assessed, together with a notice specifying the time and place in the county where the commission shall meet to hear any person interested in or aggrieved by such determination; such service shall be made by delivering the same to each of said owners or to any one of several owners or to the tenant of any such lands or properties; or by posting the same upon any such lands or properties; such service shall be made at least fifteen days before such meeting, and said statement and notice shall also be published in at least two newspapers published in the county wherein said meeting is to be held at least two weeks immediately prior thereto. The affidavit of said service and publication shall be evidence thereof. The commission shall meet at the time and place specified in such notice, or at the times and places to which said meeting may be adjourned by the commission or any member thereof, and hear all persons interested in or aggrieved by such determination; after such hearing or hearings the commission may change or modify such determination, in which case it shall specify such change or modification in a statement thereof to be signed and filed by it in like manner as hereinbefore provided with reference to such original determination. Any person aggrieved by such determination as originally made or as so modified may review the same in like manner as a review is had of the determination of a board of assessors in making an assessment. And such determination as so modified and as further modified by any final judgment or order made in proceedings to review the same as herein provided shall be final and conclusive, and the amount of the total cost and expense of such improvement and the maintenance thereof and the bonds and certificates to be issued as in this article provided and the interest thereon, which said several parcels of land and properties are to pay and bear shall be based upon the amount of the benefit accruing to them respectively as specified in and in accordance with said determination as so modified, as *hereinafter* provided, provided, however, that if any of the properties included in such improvement district and in such determination shall cease to exist, so that no part of the tax to be levied thereon as herein provided can be collected against the same, and due proof thereof shall be made to the commission, the commission may apply to the supreme court for an order to show cause why such property should not be thereafter omitted from the assessment roll of the town or city wherein the same is situated, as herein provided; such order to show cause shall be served upon the owner or owners of all the properties in such improvement district, so far as the same can be ascertained, in such manner as the court shall direct, and in case the court shall upon the return of said order so direct the said property shall be thereafter omitted from the assessment roll of said town or city, with the same force and effect in all respects as if the same had not been included in such improvement district, or in said determination. The commission shall annually transmit to the board of supervisors of each county in such improvement district a statement of the amount required to be paid by the lands and properties in said county included in such improvement district, as specified in the determination of the commission, of bonds issued for such improvement maturing during the then ensuing year together with interest thereon, and of the certificates issued by the commission as herein provided remaining unpaid and interest thereon and of the cost of the maintenance of such improvement for such year, which statement shall be approved by the comptroller, and thereupon said board of supervisors shall cause the same to be levied and collected as hereinafter provided.

§ 19. **Proceedings for assessment and collection of cost of river improvements.**— For the purpose of raising money to meet the said bonds and certificates and the interest thereon, and to provide for the cost and expenses of such improvement and the maintenance thereof the commission shall annually transmit to the comptroller a statement of the amount of the proportion thereof to be paid by the state during such year, in conformity with the determination of the commission in respect thereto as provided in section twelve of this chapter and such amount shall be by the comptroller paid into the river improvement fund herein mentioned applicable to such improvement out of the moneys of the state appropriated for that purpose; and the commission shall annually transmit to the clerk of the board of supervisors of each county, the clerk of each town, the mayor of each city and the president of each village affected by such improvement a statement of the amount of the proportional share thereof to be paid by such county, town, city or village respectively, as determined by the commission, and such county, town, city or village shall cause the same to be assessed, levied and collected in the same manner as provided by law with reference to general taxes, and paid to the treasurer of the county, who shall forthwith forward the same, less his legal fees therefor, to the comptroller to be by him paid into the river improvement fund applicable to such improvement; and the commission shall annually transmit to the clerk of the board of supervisors of each county included in such improvement district a statement of the amount of the proportional share thereof to be borne by the lands and properties collectively in such improvement district within such county during such year, to be assessed, levied and collected as hereinafter provided. The assessors of each town and city included in such improvement district are hereby required to enter upon a separate page in the annual assessment roll of such town or city before the delivery thereof to the board of supervisors the description by number corresponding with the number thereof on said survey map and descriptions so filed in the county clerk's office, each parcel of land and each designation or description of property within the county in such improvement district, together with the name of the then owner or owners thereof so far as the same can be ascertained by the assessors, and set opposite such number and description of each separate parcel or property in the column of said roll for the total assessed valuation of property the amount of benefit by reason of such improvement received by such parcel or property as stated and specified in the determination of the commission as modified by the court if so modified, on file in the office of the clerk of the county. And the board of supervisors shall each year at the time the annual tax levy is made, levy upon each separate parcel and property in said county within such improvement district appearing upon the assessment rolls of the towns and cities included therein as herein provided such portion of the amount to be paid by all of the property in said county within such improvement district appearing by the statement of the commission and the comptroller made to said board as in section eighteen of this article provided as the amount so assessed against such parcel or property on said rolls for benefit accruing thereto bears to the aggregate amount so assessed on said rolls against all of said lands and properties, and the said taxes so levied shall be collected in the same manner as general taxes are levied and collected, and shall be a like lien as general taxes until the amount thereof is paid to the general treasurer of the county, superior in force and effect to all other liens except unpaid general taxes; provided, however, that the collection of such tax shall only be enforced by a sale of the land or property assessed. Such taxes when collected shall be paid to the treasurer of said county who shall forthwith pay the same less his legal fees to the comptroller who shall pay the same into the river improvement fund.

§ 20. **River improvement certificates.**— To temporarily provide for the expenditures which must be made for such improvement before the proceeds of the sale of the bonds hereinbefore authorized to be issued become available, and to provide for the failure to collect in the manner herein provided in any year the amount required to pay the bonds and interest maturing in that year and the cost of the maintenance for that year of such improvement, the commission is hereby authorized to issue and sell certificates of indebtedness bearing interest at a rate not exceeding six per centum per annum, and the proceeds thereof shall be paid into the river improvement fund applicable to such improvement. A separate issue of certificates may be made for each improvement, the amount thereof to be approved by the comptroller, and not to exceed the aggregate estimated cost of such improvement. Such certificates shall be issued in the name of the commission; signed by the president and attested by the secretary thereof, with the seal of the commission attached, and shall be countersigned by the comptroller and the principal and interest thereof shall be payable upon the requisition of the commission.

§ 21. **Operation, maintenance and expenses of river improvements and unlawful opening of gates of dam.**— The care, control, operation and maintenance of improvements to rivers and water courses provided for in this article shall devolve upon the commission. The commission shall have power to charge to each such improvement undertaken by it such portion of the expenses incurred as it shall determine ratably and equitably is chargeable thereto and to include the same in the apportionment or assessment of the cost and expenses of such improvement. Any person who shall open or close or cause to be opened or closed a gate or gates in any dam constructed under this article so far as the same relates to such improvements without the consent of the commission, shall be guilty of a misdemeanor.

§ 3. Such chapter is hereby amended by inserting therein after section twenty-two, two new sections to be section twenty-two-a and section twenty-two-b thereof to read as follows:

§ 22-a. **Duties and qualifications of collectors and other officers.**— It shall be the duty of each collector and other official to whom is delegated the performance of any service under the provisions of this chapter to faithfully perform the same, and the collector of each town and the treasurer or collecting officer of each city whose duty it shall be to collect assessments as herein provided shall before entering upon the discharge of his duties execute to the people of the state an undertaking with two or more sureties in the penal sum of twice the amount to be collected by him, and such undertaking shall be approved and filed in the same manner and with the same force and effect as provided by law with reference to an undertaking for the collection of general taxes, and shall provide that he will well and faithfully perform his duty as collector and will pay over to the treasurer of his county and fully account for all moneys received by him under the provisions of this chapter within the same time as provided by law with reference to general taxes. And such collecting officer shall be entitled to receive the same compensation as fixed by law for the collection of general taxes. And each county treasurer whose duty it shall be to receive any assessments or moneys as herein provided shall, before entering upon the discharge of his duties, execute to the people of the state an undertaking in such amount and with such sureties as shall be required by the comptroller, conditioned that he will forthwith pay over to the comptroller upon the receipt thereof by him and account for all moneys which shall come into his hands under the provisions of this chapter and will well and faithfully perform all the duties required of him thereunder.

§ 22-b. **Ratification of proceedings for improvements.**— All proceedings heretofore taken under the provisions of this article, chapter seven hundred and thirty-four of the laws of nineteen hundred and four, and the acts amendatory thereof and supplemental thereto are hereby legalized, ratified and confirmed.

§ 4. This act shall take effect immediately.

APPENDIX D.

RULES OF THE COMMISSION GOVERNING WATER SUPPLY APPLICATIONS.

APPENDIX D.

RULES OF THE COMMISSION GOVERNING WATER SUPPLY APPLICATIONS.

RULE I.

Before any municipal corporation or other civil division of the State of New York, or any board, commission or other body of or for any such municipal corporation or other civil division of the State, or any person or waterworks corporation engaged in supplying or proposing to supply the inhabitants of any municipal corporation with water shall have power to acquire, take or condemn lands for new or additional sources of water supply, such persons, corporation or civil division shall make application to the State Water Supply Commission for approval of its maps and profiles of such new or additional source or sources of water supply.

RULE II.

Such application shall be made by petition in writing to said State Water Supply Commission at its office, in the Lyon Block, in the city of Albany, N. Y.

RULE III.

Such application shall be accompanied by: (1) An exhibit of maps of the lands to be acquired and profiles thereof showing the sites and areas of the proposed reservoirs and other works, the profiles of the aqueduct lines and the flow lines of the water when impounded; (2) plans and surveys and an abstract of official reports relating to the proposed plan showing the need of such municipal corporation for a particular source or sources of supply and the reasons therefor; (3) a plan or scheme to determine and provide for the payment of proper compensation for any and all damages to persons or property whether direct or indirect which will result from the acquiring of said lands and the execution of said plans; (4) the names of all municipal corporations and other civil divisions of the State affected by the proposed project and the names of the chief executive officers thereof; namely, in cities, the mayor; in villages, the president of the board of trustees or directors; and in other civil divisions, the supervisors of the towns; (5) a plan or scheme showing that such plans are just and equitable to said municipal corporations and other civil divisions and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply; (6) a sheet of the United States geological survey showing the location of the territory to be served, the territory to be acquired and the watershed; (7) proof of the character and purity of the water supply proposed to be acquired by certificates of experts who have made chemical and bacteriological analyses; (8) and where petition is made by a person or waterworks corporation, by an undertaking in such sum and with such sureties as shall be approved by the president of this Commission, conditioned that the expenses of the hearing and determination will be paid by the petitioner.

RULE IV.

Upon the receipt and filing of such application, maps, profiles and papers, the Commission shall thereupon give public notice that on a certain day the Commission will meet at its office in the city of Albany or at such other place as it may particularly specify in said notice for the purpose of hearing all persons, municipal corporations or other civil divisions of the State that may be affected thereby.

RULE V.

Such notice shall be published in such newspapers and for such length of time not exceeding four weeks as the Commission shall by resolution determine.

Proof of the publication of said notice shall be filed in the office of the State Water Supply Commission prior to the day specified in said notice for the day of hearing.

RULE VI.

At any time prior to the day specified in such notice any person or municipal corporation or the proper authorities of any civil division of the State may file in the office of the Commission at Albany objections to the project proposed by such application.

RULE VII.

Every objection so filed must be in writing and shall particularly specify the ground thereof.

RULE VIII.

No person, municipal corporation or local authorities shall be heard in opposition to the project proposed by such application, except on objections filed as provided by Rules VI and VII.

RULE IX.

Amendments to the application and to the objections may be permitted by the Commission.

RULE X.

The Commission shall upon the day specified in said notice or upon such subsequent day or days to which the Commission may adjourn the hearing proceed to examine the said map and profiles, plans and papers filed and to hear the proofs and the arguments both oral and written submitted in support and in opposition to the proposed project.

RULE XI.

The Commission require that particular attention shall be given by the proofs and arguments to the following questions:

(1) Are the plans proposed by the application justified by public necessity?

(2) Are such plans just and equitable to the other municipal corporations and civil divisions of the State affected thereby and to the inhabitants thereof; particular consideration being given to their present and future necessities for sources of water supply?

(3) Do said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property both direct and indirect which will result from the execution of said plans?

RULE XII.

The Commission shall within ninety days after the final hearing and with all convenient speed approve such application either as presented or with such modifications in the plans submitted as may be deemed necessary to protect the water supply and the interests of any other municipal corporation, civil division of the State or the inhabitants thereof, or to bring into cooperation all municipal corporations or other civil divisions of the State which may be affected thereby, or it may reject the application entirely or permit another to be filed in lieu thereof.

RULE XIII.

The decision of the Commission on any application submitted to it, shall be stated in writing, shall be signed by it and have affixed thereto its official seal and the same shall be filed together with all plans, maps, surveys and other papers or records relating thereto in its office.

RULE XIV.

The expense of such hearing and determination by the Commission will be certified by the Commission under its official seal to the person, waterworks corporation, municipal corporation or other civil division of the State making application for approval of plans, etc., and the same shall be paid by the said applicant within thirty days thereafter upon the certificate of the Commission, to the persons entitled thereto.

RULE XV.

Any three of the Commissioners shall constitute a quorum for the transaction of business.

RULE XVI.

All maps, plans, records, surveys and other papers filed in the office of the Commission by any applicant or objector may be examined by any person or persons at the office of the Commission, but shall not be removed therefrom except upon the written authority of the Commission.

RULE XVII.

All maps shall be on paper or cloth 27″x40″ (double elephant) or folded to those dimensions and all other written matter shall be upon legal cap of legal weight and size.

APPENDIX E.

FINANCIAL STATEMENTS.

APPENDIX E.

I.

CLASSIFIED STATEMENT OF GENERAL OFFICE EXPENDITURES, FEBRUARY 1, 1909, TO FEBRUARY 1, 1910.

Appropriations.

Feb. 1.	Unexpended balance of former appropriations	$27,492 70
May 24.	By supply bill, Chapter 433, Laws of 1909	1,000 00
Oct. 1.	By appropriation bill, Chapter 432, Laws of 1909	38,147 35
		$66,640 05

Disbursements.

Salaries of commissioners	$24,731 28	
Salaries of officers	7,966 68	
Traveling Expenses of commissioners	2,597 19	
Traveling expenses of officers	536 45	
Office expenses, printing, stationery, furniture, telegraph and telephone, postage etc.	1,428 95	
Rent of office	1,050 02	
Collecting statistics	585 00	
Reverted to State	15 06	
		38,910 63
Balance February 1, 1910		$27,729 42

II.

CLASSIFIED STATEMENT OF EXPENDITURES FOR WATER POWER INVESTIGATIONS, FEBRUARY 1, 1909, TO FEBRUARY 1, 1910.

Appropriations.		
February 1, 1909, balance of former appropriations		$7,883 32
May 24, 1909, by Chapter 433, Laws of 1909....		30,000 00
		$37,883 32
Disbursements.		
Compensation of consulting engineer..	$2,500 00	
Expenses of commissioners..........	1,105 10	
Salaries of engineering force........	20,401 51	
Office rent and equipment...........	380 33	
Maintenance expenses of engineering force..........................	1,013 41	
Traveling and sundry expenses of engineers..........................	2,013 79	
Livery and boat..................	1,532 32	
Engineering supplies	335 16	
Maps, blue prints and photographs..	269 98	
Rental and purchase of instruments...	569 82	
Test borings	332 95	
Stream gaging in co-operation with U. S. Geological Survey..........	2,806 57	
Rain gaging	269 80	
Printing and stationery............	210 34	
Telegraph and telephone............	768 13	
		34,509 27
Balance February 1, 1910................		$3,374 05

III.

CLASSIFIED STATEMENT OF EXPENDITURES FOR RIVER IMPROVEMENT SURVEYS, FEBRUARY 1, 1909, TO FEBRUARY 1, 1910.

Appropriations.		
February 1, 1909, balance of appropriation under Chapter 578, Laws of 1907		$926 94
May 24, 1909, by supply bill, Chapter 433, Laws of 1909		15,000 00
		$15,926 94
Disbursements.		
Salaries of engineering force	$10,341 29	
Traveling, maintenance and sundry expenses of engineers	957 20	
Legal expenses	1,583 79	
		12,882 28
Balance on hand, February 1, 1910		$3,044 66

IV.

CLASSIFIED STATEMENT OF EXPENDITURES FOR GENESEE RIVER IMPROVEMENT, SEPTEMBER 24, 1908, TO FEBRUARY 1, 1910.

Appropriation.

May 22, 1908, by supply bill, Chapter 466, Laws of 1908		$25,000 00

Disbursements.

Salaries of engineers	$21,341 28	
Expenses of engineers	2,083 78	
Test borings	1,071 50	
		24,496 56
Balance February 1, 1910		$503 44

LIST OF PLATES.

PAGE.

I. **New York State** — Diagram illustrating growth and present development of water power compared with possible development by means of state water storage reservoirs 62

II. **Hudson River** — Diagram illustrating regulating effect of proposed storage reservoirs on the flow in the vicinity of Spiers Falls 64

III. **State Land** — Diagram showing comparatively small amount required for complete system of state storage reservoirs in the Adirondack Park 100

IV. **Genesee River** — Diagram showing probable regulating effect of the proposed storage reservoir on a flood such as that of May, 1909 140

V. **Genesee River and Canaseraga Creek** — Map of improvement districts and proposed alternative storage reservoirs............ 144

VI. **Rainfall** — Map showing lines of equal rainfall in New York State — Mean annual precipitation in inches 176

VII. **Sacandaga Reservoir** — Diagram illustrating typical regulating effect on the flow of the Hudson river in the vicinity of Spiers Falls 188

VIII. **Adirondack Region** — Map showing location of proposed and future possible reservoirs and state lands involved.......... Pocket

IX. **Sacandaga Reservoir** — Topographic map of the proposed reservoir .... Pocket

X. **New York State** — Map showing location of all water storage and power possibilities investigated under provisions of chapter 569, Laws of 1907.............................. Pocket

LIST OF ILLUSTRATIONS.

PAGE.

AUSABLE RIVER — The Flume ..... Frontispiece
  Dam site, proposed Cherry Patch Pond reservoir 270
  High Falls 270
BLACK RIVER — Power dam at Herrings 236
GENESEE RIVER — Avon Highway — Flood of May 3, 1909 314
  An example of damage done by floods 318
  Cuylerville bridge — Flood of May 3, 1909 314
  Geneseo bridge — Highway and farm lands flooded 314
  Jones bridge — View upstream during flood 24
  Erie railroad — Flood conditions May 3, 1909 318
  New York State Industrial School farm near Oatka during flood May 3, 1909 314
  Rochester — Flood at Erie Canal aqueduct 318
    Flood at Main Street bridge reaching danger point 318
    Falls — May 4, 1909 — Waste of flood water 192
    Site of falls, October, 1908 (dry), usual summer conditions 192
OSWEGATCHIE RIVER — Cranberry lake — An artificial reservoir 248
  Dam at Cranberry lake outlet 248
RAQUETTE RIVER — Big Tupper lake — Low water conditions 292
  Cold river, foot of Long lake 306
  Dam site on Bog river below Little Tupper lake 306
  Dam site, Forked lake outlet 306
  Lower Raquette falls 306
  Raquette pond — Stump lands above dam site No. 1 292
  Slim pond — Dead timber and swamps 298
  Sperrybrook swamp in Little Tupper lake reservoir 298
SARANAC RIVER — Flowed lands — Vicinity of Flower lake 270
  Flowed lands — Vicinity of Flower lake 278
  High Falls 266, 278
  Swamp land between Lake Flower and lower Saranac lake 148
  Swamp land between Lake Flower and lower Saranac lake 278
ST. REGIS RIVER — St. Regis Falls — View down stream 254
  St. Regis Falls — View up stream toward dam site 254

GENERAL INDEX.

GENERAL INDEX.

PAGE.
Adirondack Mountain Reserve Society ... 274
Adirondack mountains:
  Natural conditions favorable for storage in ... 92
  State lands required for storage in ... 99, 180
Allegany river ... 89, 322
  Report on reconnaissance of ... 322
Applications for approval of water supply plans ... 13, 383
  Rules of the commission governing ... 461
  Table of progress on plants approved ... 135
Appropriations. (*See* "Financial Statements.")
Areas of drainage basins and of State lands required.
  (*See* names of rivers and "State lands.")
Arietta flow ... 45, 53
Ausable river ... 88, 147, 267
  Cherry Patch Pond reservoir ... 147, 270
  Clintonville project ... 268
  East branch of:
    Indian Face project ... 272
    Jay project ... 271
    Keene project ... 272
    Keene-Jay project ... 272
    Reconnaissance of ... 271
  Flume project ... 269
  Keeseville project ... 267
  Practicable power developments, table of ... 275
  Present developments ... 267
  Reservoir sites possible ... 273, 276
  Rome project ... 268
  Wilmington project ... 269
  Wilmington Notch project ... 270
Auxiliary:
  Power plants ... 63, 174
  Regulating reservoirs ... 173
Bainbridge, water supply of village of:
  First application (No. 35) ... 15
  Disposition of ... 383
  Second application (No. 51) ... 13, 14, 384
  Decision on application ... 407
Barker, water supply of village of:
  Application (No. 68) ... 14
  Disposition of ... 16, 384

PAGE.
Beaver Flow 82, 156, 222
Beaver river 82, 156, 222
Big Tupper Lake reservoir (*See also* Raquette river) 79
Black river 81, 154, 212
  Appropriation needed for further studies 113
  Beaver river, tributary to 82, 156, 222
    Beaver Flow reservoir 157
    Beaver lake reservoir 157
  Commissioners of Water Power on 155
  Deep Waterways, Board of Engineers on 158
  Deer river, tributary to 82, 156, 228
    Copenhagen reservoir 157
  Estimate of available power on 217, 234
  Hawkinsville reservoir 155
  Importance of, for power development 45, 83
  Independence creek, tributary to 232
  Moose river 82, 155, 218
    State lands involved 156
    "The Plains," reservoir at 155
  Otter creek 232
  Recommendations of resident engineer concerning 237
  Report on reconnaissance of 212
  Sugar river 232
  Watershed areas of 214
Blue Ridge reservoir 146
Bog river, discharge of, near Tupper lake 373
Bolster, R. H 331
Boquet river 89, 149, 286
  Report on reconnaissance of 286
Boreas river 53
Borings at Tumblehead Falls, Schroon river 146
Brant lake 53
Buffalo creek 89, 171, 326
Cadyville storage and power projects, Saranac river 280
Canacadea creek 321
Canajoharie, water supply of village of:
  Application (No. 57) 13, 132
  Disposition of 14, 16, 384, 420
Canal water supply 81
Canaseraga creek 20, 23, 144, 314
  Cost of storage on watershed 317
  Improvement district 316
  Reconnaissance of upper valley 316
  Storage reservoir possibilities 316
  Surveys, cost of 318
  Surveys of 1909 314
Caneadea creek, storage reservoir site on 320
Canisteo river 89, 320

PAGE.
Cannonsville reservoir project 45
Carthage, possible reservoir on Black river at 83
Cattaraugus creek 89, 170, 322
  Report on reconnaissance of 322
  Springville, dam at village of 170
  Versailles, dam at village of 170
  Zoar, dam at 170, 323
Cayuga creek 89, 171, 326
Cazenovia creek 89, 171, 326
Cedar river 53
Census of:
  Water power developments (*See also* Fourth Annual Report) 174
  Water supplies (*See* First and Second Annual Reports.)
Central Bridge Water Company:
  Application (No. 60) 13, 14, 384
  Decision on application 425
Chadakoin river 322
Chain lakes
Champlain, lake, streams tributary to 147, 267
Chateaugay river 89, 149, 284
Chautauqua lake outlet 57, 171, 322
Chazy river 89, 285
Chemung river 45, 60, 320
Chenango river 89
Cherry Patch pond reservoir, Ausable river 270
Chilson Lake reservoir 146
Clintonville project, Ausable river 268
Cochecton reservoir project 45
Cohocton river 89, 320
Commission, State Water Supply:
  Laws governing operations of 37, 439
  Personnel of commissioners and officers 4
Commissioners of Water Power on Black river 155
Conewango creek 322
Conklingville, dam on Sacandaga river at 66
Conservation of natural resources 7, 90
  New York's leadership in 7, 37
Conservation of water power resources:
  A State function 98
  Definite policy urged 44, 90
  Draft of bill to provide for 117
  Importance of 98
  Need of a public policy 93
Constitutional amendments affecting:
  Bond issue 108, 112
  State forest lands 47, 100, 101
Contents, table of 5, 6
Cooper, David R. 138, 139, 172, 173, 180

Co-operation with: PAGE.
  U. S. Geological Survey 177
  Private individuals 178
  U. S. Weather Bureau 175
  State Department of Health 133
Covert, Clermont C., District Engineer, U. S. Geological Survey 178
  Report of, on co-operative stream gaging 329
Croghan, water supply of village of:
  Application (No. 58) 13, 14, 384
  Decision on application 421
Dams (*See* names of streams.)
Decision of the commission on water supply applications 383
  (For particular decision *see* name of applicant.)
Deep Waterways, Board of Engineers on 83, 85, 207
Deer river 82, 156, 228
Delaware river 55
  Cannonsville project 45, 55
  Cochecton 45, 55
  Lackawaxen power development 45, 55
  Mongaup power development 45, 55
  Rainfall maps prepared 56
  Survey for reservoir site 45, 55
Diagrams. (*See* list of plates, page 471.)
Disbursements. (*See* "Financial Statements.")
Doty, Lockwood R. 144
Draft of bill to provide for conservation of water resources 117
East Canada creek 45
Eastern Division, report of Resident Engineer 265
Eighteen-mile creek 89, 171, 326
Eminent domain 102
Engineering organization 140, 172
Estimates of cost. (*See* under names of streams.)
Farmingdale, water supply of village of:
  Application (No. 66) 14
  Disposition of 15, 384
Financial statements, Feb. 1, 1909, to Feb. 1, 1910. (Appendix E.)
  I. General office expenditures 467
  II. Water power investigations 468
  III. River improvement surveys and investigations 469
  IV. Genesee river improvement 470
Floods:
  In Genesee valley 75, 313
Flume project, Ausable river 269
Forest fires, in Raquette river watershed 309
Forestport, storage reservoir at 214
Forests:
  In western New York 323
  Relation of, to run-off 91

PAGE.

Forked Lake reservoir, proposed 301
  Estimated cost 154
  Plan for tunnel connecting Little Tupper lake 153
  Survey made 154
  Total cost of combined projects 154
Franklin Falls, Saranac river:
  Power project 279
  Reservoir project 278
Freeman, John R.:
  Consulting engineer, 1908 investigations 52
  In charge of 1907 investigations 49
Fuller act (chapter 569, Laws of 1907) 37
  Analyzed 105
  General provisions of 42
  Report on investigations under 37
Fulton Chain Lakes, artificial storage at 82
Fultonville Water Co. (*See also* "Canajoharie, Village of.")
  Application (No. 52) 13
  Disposition of application 14, 384
Gaging. (*See* "Stream gaging" and "Rain gaging.")
Genesee Falls 140, 171
Genesee river 74, 311
  Flood elevations on 312
  Flood of May, 1909 313
  Report of resident engineer on 311
  Reservoir sites on 319
  Stream gaging 357
    At Jones' Bridge, near Mt. Morris 362
    At Mt. Morris 361
    At St. Helena 358
  Surveys on 19, 311
Genesee river improvement:
  Alternative plan for 26, 74
  Cost of surveys 318
  Description of valley 25
  Floods data on 140, 141
  Mean annual rainfall 74
  Mount Morris gorge project 25
  Portage project 26, 74
    Annual maintenance charge 193
    Capacity for storage 74
    Cost 75
    Revenue 76
  Studies of 1907 50
  Studies of 1908 54
  Topographical survey of valley 55
Glens Falls, water supply of city of:
  Application (No. 49) 13, 14, 384
  Decision on application 393

PAGE.

- Gowanda, reservoir site on Cattaraugus creek above 323
- Grass river 86, 164, 248
  - Estimate of available power on 165, 250
  - Recommendations of resident engineer concerning 252
  - Reconnaissance of 86
  - Report of resident engineer on 86, 248
  - Reservoir at Clare 164
  - Reservoir at DeGrasse 164, 165
  - Reservoir at Grass river flow 164
  - Watershed areas of 252
- Hadley, discharge of Sacandaga river near:
  - At Highway bridge, west of Hadley 352
  - At Union Bag & Paper Company's Mill 356
- Hadley reservoir, on Hudson river 45
- Hannawa Falls 194
- Haslam, Erwin E., resident engineer 139, 145, 150
  - Report of 289
- Hawkinsville project, Black river 215
- Headquarters division 172
- Health, State Department of 133
- High Falls power project, Saranac river 279
- Hoyt, W. G 331
- Hudson river:
  - Comparative advantages of Sacandaga and Schroon projects 73, 188
  - Opportunities for water storage and power development on 64
  - Petitions for improvement of 27
  - Reconnaissance of 52
  - Sacandaga project. (*See also* "Sacandaga River.") 66, 188
    - Advantages of compared with Schroon 188
    - Conklingville dam 69
    - Future work on 287
    - State lands not involved 73
    - Surveys and investigations 49, 52, 146
  - Schroon project. (*See also* "Schroon River.") 70, 190
    - Advantages of compared with Sacandaga 190
    - Surveys and investigations 52, 146
  - Stream gaging 332
    - At Mechanicville 339
    - At North Creek 334
    - At Thurman 336
- Hudson river improvement 27
- Hughes, Governor 9, 58, 104
- Hydrographic studies 1908 56
- Hydrographic studies 1909 60
  - Report of C. C. Covert on stream gaging 331
- Illustrations, list of 472
- Improvements of rivers. (*See* "River Improvements.")
- Independence creek 82, 154, 232
- Indian Face project, Ausable river 272, 273

PAGE.
Indian river, tributary to upper Hudson ... 53
Indian river, tributary to Oswegatchie ... 84, 163, 238
Investigations, under chapter 569, Laws of 1907 ... 42
  Scope of ... 93
  Summary of results ... 44
Jamaica Water Supply Company:
  Application (No. 69) ... 14
  Disposition of ... 16, 384
James, W. A. ... 331
Jay project, east branch of Ausable river ... 271
Jones Bridge, discharge of Genesee river at ... 362
Keene project, east branch of Ausable river ... 272
Keene-Jay project, east branch of Ausable river ... 272
Keeseville project, Ausable river ... 267
Lackawaxen power development, Delaware river ... 45
Lake Erie, minor streams tributary to ... 326
Lake George outlet ... 149, 286
Lake Ontario, minor streams tributary to ... 326
Lake Pleasant reservoir ... 45
Land Office, Commissioners of ... 73
Lands, State. (*See* "State Lands.")
Laws relating to the Commission ... 439
  River improvement ... 8, 19, 20
    Article 2, chapter 54, Consolidated Laws ... 439
    Chapter 284, Laws of 1909 ... 450
    Chapter 464, Laws of 1909 ... 451
  Water power ... 7, 8, 19
    Draft of proposed bill for general law to provide for conservation of water resources ... 117
    Fuller Act (Chapter 569, Laws of 1907) ... 37
    Provisions of ... 42, 105, 185
  Water supply ... 7
    Article 2, chapter 54, Consolidated Laws ... 439
Letchworth Park, effect of Portage reservoir on ... 74
Levels:
  Genesee flood ... 314
  Raquette river, 1908 and 1909 ... 289
Little Tupper-Round lake reservoir ... 45, 59, 79, 153, 298
  Colton, regulation of stream at ... 195
  Estimated cost ... 152
  Increase of power on Raquette river ... 196
  Tunnel plan connecting Forked lake ... 153
Livonia, water supply of villages of:
  Application (No. 63) ... 13, 14, 384
  Decision on application ... 431
Local river improvements ... 28
Long lake ... 79, 293, 307, 308
Lower Saranac lake reservoir ... 277

McCulloh, Walter, Consulting Engineer: PAGE.
In charge of 1908 studies 52
Recommendations and conclusions summarized 185
Report on river improvement 137
Report on water power investigations 137, 146
Report on water supply 131
Maps 179
Adirondack region — Location of proposed and future possible reservoirs and State lands involved (Plate VIII) .... Pocket
Genesee river and Canaseraga creek improvement districts and proposed alternative reservoir sites (Plate V) 144
Rainfall — Map of New York State showing annual precipitation in inches (Plate VI) 176
Sacandaga reservoir (Plate IX) .... Pocket
Water power and storage possibilities investigated (Plate X) .... Pocket
Market for power:
Genesee project 76
Sacandaga project 69
Massena springs, discharge of Raquette river at 371
Mechanicville, discharge of Hudson river at 339
Mechanicville, water supply of village of:
Application (No. 59) 13, 14, 384
Decision on application 423
Minor streams, tributary to Lakes Erie and Ontario 171, 326
Possibilities of improving 198
Mohawk river 45
Mongaup power development, Delaware river 45
Moose river 82, 155, 218
Morrisonville power project 281
Mount Morris, discharge of Genesee river at 361
Storage reservoir project in gorge above 26, 142
Mount Morris, water supply of village of:
Application (No. 64) 13
Disposition of 14, 16, 384
Municipal water supply. (*See* "Water Supply.")
Nassau county sources of water supply:
New York city (Application No. 50) 15, 384
Decision on application 396
Natural resources. (*See* "Conservation.")
Neely, William R., resident engineer 139
New York, water supply of city of:
Catskill mountain sources (Application No. 1) 137, 383
Catskill aqueduct, modification of route (Application No. 67) 14
Disposition of 15, 16, 384
Nassau county sources (Application No. 50) 13, 14, 15, 384
Decision on application 396
Suffolk county sources (Application No. 40) 15
Disposition of 16, 384

PAGE.
Niagara Falls, water supply of city of:
  Application (No. 55) ... 13, 14, 131, 137, 384
  Decision on application ... 414
North Creek, discharge of Hudson river at ... 334
Northern division:
  Reconnaissance ... 154
  Surveys ... 150
Northville, discharge of Sacandaga river at ... 349
Oak Orchard creek ... 89, 171, 326
Officers, State Water Supply Commission ... 4
Office studies, summary of ... 172
Ontario, lake, minor streams tributary to ... 326
Organization of engineering bureau ... 138
Oswegatchie river ... 84, 160, 238
  Black lake ... 84, 85
  Eelweir bridge, dam at ... 163
  Estimate of available power on ... 244
  Harrisville ... 84, 162, 163
  Indian river, Black lake project ... 163
  Newton Falls ... 84, 85, 161
  Opportunities for additional storage at Cranberry lake ... 84, 85, 161
  Power and storage possibilities ... 84
  Recommendations of Resident Engineer concerning ... 248
  Report on reconnaissance of ... 84, 238
  Watershed area of ... 238
Oswego Light and Power Company ... 85, 160
Oswego river ... 81
  Appropriation needed for further studies ... 113
  Importance of, for power development ... 45
Otter creek ... 232
Painted Post, water supply of village of:
  Application (No. 65) ... 14, 384
  Decision on application ... 434
Palenville water district:
  Application (No. 38) ... 15
  Disposition of ... 384
Paradox lake ... 146, 266
Perkins, Albert H., Resident Engineer ... 139, 146
  Report of ... 265
Petersburg, water district of town of:
  Application (No. 62) ... 13, 14, 384
  Decision on application ... 430
Photographs. (*See* "Illustrations.")
Piercefield, discharge of Raquette river at ... 368
  Dam site on Raquette river at ... 301
Piseco lake, surveys of 1908 ... 53
Plan of development suggested by Commission ... 110
Plan of report ... 47
Plates, list of ... 471
Plattsburg, power project near ... 281
Poag's Hole, reservoir site on Canaseraga creek near ... 316

PAGE.
Portage dam 54
Portage, power development at........................ 75, 192
Portage reservoir 192
  Alternative theories of State control of.............. 109
  Estimated cost 143
Possible power developments. (*See also* names of streams.)
  Summarized estimate 174
Pottersville, gaging station on Schroon lake near......... 342
Power. (*See* "Water Power.")
Public lands laws, provisions of......................... 73
Public purpose, defined.................................. 102
Public use, defined..................................... 102
Pyramid Rapids reservoir................................. 278
Rainfall:
  Additional gaging stations established................ 51
  Comparative studies of gages.......................... 175
  Co-operation with U. S. Weather Bureau.................. 46, 51
  Importance of records................................ 198
  Map of New York State showing......................... 176
  Maps of important rivers showing....................... 56
  Records and studies................................... 175
  Summary of experiments with different gages............ 176
Raquette Falls, discharge of Raquette river at............. 366
Raquette lake, State land on.............................. 294
Raquette river 77, 150, 289
  Alternative storage possibilities...................... 308
  Blue Mountain lake, State lands on...................... 294
  Cost of storage reservoirs............................ 307
  Dam sites below Tupper Lake village..................... 301
    Piercefield site 150, 152
  Evaporation 296
  Forest fires 309
  Forked lake reservoir................................. 79
  Gages from Piercefield to Forked lake................... 295
  Ground water storage.................................. 297
  Hannawa Falls 194
  Hydrographic surveys 294
  Increase of power from Little Tupper project............ 196
  Levels 289
  Little Tupper-Round lake reservoir...................... 79, 152, 298
  Long lake reservoir................................... 79
  Piercefield, dam at.................................. 150, 302
  Reconnaissance of 54, 289
  Relocation of N. Y. C. R. R............................ 303
  Reservoir sites, comparative features and cost.......... 307, 308
  Sequence of reservoir construction...................... 308
  Settingpole rapids dam................................ 145, 291
  Slim pond reservoir, capacity and cost.................. 307
  State lands involved.................................. 79, 294
  Storage requirements 305

Raquette river — *Continued:* PAGE.
- Stream gaging records, 366
  - At Bog River Falls, 373
  - At Massena Springs, 371
  - At Piercefield, 368
  - At Raquette Falls, 366
- Surveys, 52, 289, 292
- Triangulation, 290
- Tupper lake project, 79
  - Cost, estimate of, 305
  - Dam sites, 78, 301
  - Railroad relocation, 303
- Watershed, description of, 366

Recommendations of Commission, 112

Reconnaissance studies, 45, 80
- Allegany, 45, 57, 60, 89
- Ausable, 45, 267, 271
- Black, 60, 81, 154
- Boquet, 45, 89
- Buffalo creek, 89
- Canisteo, 89
- Cattaraugus creek, 45, 60
- Cayuga creek, 89
- Cazenovia creek, 89
- Chateaugay, 45
- Chazy, 45, 89
- Chemung, 60
- Chenango, 45, 89
- Cohocton, 89
- Eastern division, 267
- Eighteen Mile creek, 89
- Genesee, 80
- Grass, 45, 86
- Hudson, 80
- Lake Chautauqua, 57
- Lake George, 57
- Lake Oneida, 57
- Minor streams, 45
- Oak Orchard creek, 89
- Oswegatchie, 57, 84
- Raquette, 54, 80
- St. Regis, 45, 86
- Salmon (Franklin county), 45
- Salmon (Oswego county), 45, 85
- Saranac river, 45, 276
- Susquehanna, 45, 89
- Upper Genesee, 89
- Western division, 318

Rensselaer Water Company:
- Application (No. 54), 13, 14, 384
- Decision on application, 412

Reports: PAGE.
  Commission, State Water Supply.... 7
    Part I.— Municipal water supply.... 13
    Part II.— River improvement and flood prevention.... 19
    Part III.— Water storage and power development.... 37
  Covert, C. C., district engineer, U. S. Geological Survey.... 331
  Haslam, Erwin E., resident engineer.... 289
  McCulloh, Walter, consulting engineer.... 131
  Perkins, Albert H., resident engineer.... 265
  Rhodes, Charles T., resident engineer.... 311
  Thornley, Julian, resident engineer.... 201
Reservoirs. (*See also* names of streams.)
  Auxiliary regulating.... 173
  Relation of storage to power development.... 62
  State control of.... 109
Resources, natural. (*See* "Conservation.")
Rhodes, Charles T., resident engineer.... 23, 139
  Report of.... 311
River improvement and flood prevention:
  Apportionment and assessment of benefits.... 22
  Canaseraga creek improvement.... 23
  Genesee river improvement.... 24, 75
  Hudson river improvement.... 27
  Local river improvement.... 28
  Procedure, order of, before Commission.... 21
  Report of Commission on.... 19
  Report of consulting engineer on.... 137
  River improvement districts.... 20
Riverbank, discharge of Schroon river at.... 342
River gaging. (*See* "Stream Gaging.")
Rochester, benefits of Genesee project to.... 76, 193
Rome project, Ausable river.... 268
Rivers. (*See* names of.)
Ropes, Horace, in charge of 1908 studies.... 52
Round Lake. (*See* "Little Tupper-Round Lake.")
Rules of Commission governing water supply applications.... 461
Run-off. (*See also* "Stream Gaging" and names of streams.)
  Influence of forests on.... 91
Sacandaga river.... 66, 146, 287
  Arietta flow.... 53
  Sacandaga reservoir:
    Advantages of, compared with Schroon.... 73, 190
    Capacity for storage.... 65, 66, 189
    Conklingville, dam at.... 188
    Cost.... 69, 70, 189
    Market for power.... 69
    Revenue estimated.... 69, 189
    Value of stored water.... 67
    Work remaining to be done on.... 288

Sacandaga river — *Continued:* PAGE.
  Stream gaging 345
    At Hadley, Union Bag and Paper Company's mill 356
    At highway bridge west of Hadley 352
    At Northville 349
    At Wells 346
  Surveys of 1907 and 1908 .... 49, 53
St. Helena, discharge of Genesee river at 358
St. Lawrence river 168, 263
St. Regis river 86, 165, 253
  Estimate of available water power on 257
  Recommendations of resident engineer concerning 258
  Report on reconnaissance of 253
Salmon river (Franklin county) 87, 167, 258
  Recommendations of resident engineer concerning 261
  Report on reconnaissance of 258
  Reservoir at Titusville 167, 168
  State land involved 167
  Watershed areas of 261
Salmon river (Oswego county) 85, 158, 206
  Altmar, power possibility at 159
  Estimate of available power on 209
  Recommendations of resident engineer concerning 211
  Redfield, storage and power project near 159, 206
  Report on reconnaissance of 206
  Reservoir, cost of 85
  Salmon Falls, principal power possibility at 159
Saranac river 87, 148, 276
  Cadyville storage and power projects 148, 280
  Franklin Falls power project 148, 279
  Franklin Falls reservoir 278
  High Falls power project 279
  Lower Saranac lake reservoir 277
  Morrisonville power project 281
  North branch, possibilities on 279
  Plattsburgh, power project near 148, 281
  Power developments, table of 283
  Power possibilities on 279
  Pyramid Rapids reservoir 278
  Reconnaissance of, report on 276
  Reservoirs proposed 284
  Run-off characteristics of watershed 276, 277
  Saranac village power project 148, 280
  Storage reservoirs, possibilities for 148, 276
  Tefft Falls power project 279
  Union Falls power project 279
  Union Falls reservoir 148, 278
  Upper Saranac lake reservoir 148, 278
Schroon Falls reservoir 146

PAGE.

- Schroon river, 70, 146, 266
  - Alternative projects, 70
  - Comparative advantages of Schroon and Sacandaga projects, 73, 190
  - Discharge measurements, 71
  - Mean annual rainfall, 71
  - Paradox lake survey, 146
  - Reservoirs, 65, 70, 190
  - Stream gaging, 341, 342
  - Surveys in 1908, 52, 53
- Settingpole dam, 291
- Sewage disposal, 133
- Shedd, George G, 319
- Shortsville, water supply of village of:
  - Application (No. 44), 15
  - Decision on application, 385
- Silver lake outlet, 320
- Springville, reservoir site on Cattaraugus creek near, 323, 324
- Stadia surveys, cost of, in western division, 318
- State fair exhibit, 179
- State lands in Adirondack forest preserve:
  - Amount of, involved in storage projects, 77, 99, 180, 205
  - Constitutional amendment affecting, proposed, 47
  - Estimates of lands involved in storage projects, 47, 60, 180
  - Plan for replacing lands taken for storage, 101
  - Table of amounts involved, 182
- State ownership and control of reservoirs, 83, 94
  - Alternative theories, 109
  - Constitutional aspects of, 101
  - Importance of, 94
  - Reasons for, 95
- State policy, recommendation for, 186
- State Water Supply Commission:
  - Laws governing operations of, 37, 439
  - Personnel of Commission and officers, 4
  - Personnel of engineering organization, 138
  - Brief history of, 8
- Statistics. (*See* "Water Power" and "Water Supply.")
- Stony brook, tributary to Canaseraga creek, storage on, 317
- Storage reservoirs. (*See also* names of streams.)
  - Indirect benefits from, 106
  - Relation to power development, 62
  - Stimulus to industrial energy, 107
- Stream gaging, C. C. Covert's report on, 331
  - Field data, accuracy and reliability of, 332, 378
  - New stations established, 46, 177
  - Table of comparative discharge, 376
- Suffolk county sources of water supply:
  - New York city (Application No. 40), 15
  - Decision on application, 16, 384